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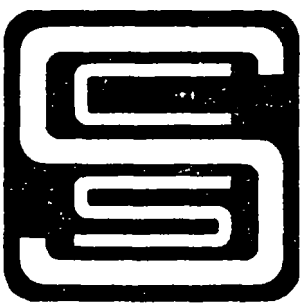

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FINAL REPORT

PREPARATION OF CLOSURE/POST-CLOSURE AND CONTINGENCY PLANS FOR PINE BLUFF ARSENAL

Contract No. DACA 63-81-C-0173

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SECTION 1

EXECUTIVE SUMMARY

In August 1980, the Army Environmental Hygiene Agency (AEHA) conducted a survey of the 42 waste treatment, storage, and disposal facilities at Pine Bluff Arsenal (PBA). It was concluded that 31 of these sites would require closure/post-closure and contingency plans. Three of the sites would require run-on/runoff control plans.

The 31 sites (three containing nonhazardous wastes and 28 containing hazardous wastes) vary in area, waste types, and other features, and range from modern operating facilities (e.g., the incinerator complex) to abandoned burning grounds and waste storage/disposal areas (e.g., white phosphorus settling pond, old toxic storage yard). Available data indicate that some of these sites (e.g., the NCTR equalization pond and impregnite sludge lagoon) pose only a minimal environmental threat. Other sites (e.g., the mustard agent burning yard and the depot south burning pit) may pose the threat of significant environmental degradation.

To comply with the U.S. Environmental Protection Agency's (EPA) Part B permit application under Subtitle C, Section 122, of the Resource Conservation and Recovery Act (RCRA), 31 conceptual closure and post-closure plans were prepared under this contract. These conceptual plans also provide the U.S. Army Corps of Engineers (COE) with preliminary design and cost estimates. In addition, run-on/runoff control plans for three sites and a contingency plan for PBA were also prepared.

The conceptual plans were developed on the basis of (1) interim status standards for closure and post-closure (40 CFR 265, Subpart G); (2) site observations and discussions with engineers and other professionals familiar with the sites; (3) information provided by PBA and COE staff; and (4) an engineering assessment. The conceptual plans present the types of actions deemed necessary to isolate the wastes contained at the sites from the natural environment and to prevent migration of contaminants after site closure. These conceptual plans fulfill the site closure requirements in a cost-effective manner.

In many cases, the available data regarding the extent of waste deposits and subsurface physical conditions are incomplete. Thus, assumptions were made based on the available data so that conceptual closure and post-closure plans could be developed.

Some of the plans are subject to change depending on the findings of additional subsurface investigations.

It will be necessary to determine the characteristics of the wastes and contaminated soils found at each site according to RCRA-defined procedures. The geotechnical investigations needed for the final design of the closure plans should be completed in conjunction with the waste characterization. Based on this body of data, some of the sites may be removed from the hazardous classification. Further, the additional data will permit assessment of both the appropriateness of the conceptual closure plans and the need for remedial actions.

In general, it would be considerably more economical to implement corrective (remedial) action, if required, in conjunction with site closure, rather than independently at different times. Completion of the additional site investigations would also facilitate prioritization of closure activities.

Included in each conceptual closure and post-closure plan are (1) a brief description of the site, (2) recommended closure procedure, estimated costs, and schedule, (3) post-closure considerations, and (4) assumptions. The drawings associated with each conceptual closure plan are presented in a separately bound plan set.

In conjunction with the specific conceptual closure and post-closure plans, general considerations commonly applied to these plans are also presented. These are (1) inspection and certification of site closure, (2) monument placement and plot plan, (3) post-closure inspection and care, (4) subsurface exploration and instrumentation, (5) borrow considerations, (6) construction control and quality assurance, (7) safety, and (8) revegetation.

A contingency plan was prepared, using existing information from the Spill Prevention Control and Countermeasures (SPCC) plan. This plan describes the action that facility personnel must take to minimize hazards to human health and the environment (including emergency procedures, equipment, and contacts) in the event of a spill or sudden release of hazardous wastes from these sites.

A waste compatibility chart is presented, based on the information on wastes or chemicals known to exist at the sites. This chart may serve as a guide for operator(s) in handling and disposing of a given waste in the secure landfill proposed for construction at PBA.

SECTION 2

INTRODUCTION

2.1 BACKGROUND

Pine Bluff Arsenal (PBA) encompasses about 15,000 acres in the northwestern portion of the Mississippi embayment, Jefferson County, Arkansas, approximately 35 miles south of Little Rock. PBA, which started operations in 1942, produces chemical smoke, riot control smoke, incapacitating incendiary, and other pyrochemical mixtures and/or munitions to supplement commercial industrial production of strategic materials.

In a recent survey of the 42 waste treatment, storage, and disposal sites at PBA, the Army Environmental Hygiene Agency (AEHA) concluded that 11 sites currently comply with standards set forth by regulations issued by the U.S. Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA).[1]* Of the remaining 31 sites, 20 require immediate attention to comply with RCRA provisions; 11 will require cleanup and closure, though not immediately. General locations of the sites are shown on Sheet 2.

2.2 SITE GROUPINGS

The 31 sites requiring closure and post-closure plans encompass a wide spectrum of facilities whose ages, sizes, waste types, and site conditions differ substantially. In view of site use status and closure needs, these sites were categorized into three groups[1]:

- Active/active sites - those requiring immediate action, and in current or standby use.
- Active/inactive sites - those requiring immediate action, but not in current use.
- Inactive/inactive sites - those no longer in use, but requiring cleanup and closure.

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* See Section 6 for reference citations.

Three of the 31 sites contain nonhazardous wastes; the other 28 are hazardous waste management facilities. Specific sites in each of the three groups (and their page numbers in text) are presented in Tables 2-1, 2-2, and 2-3.

2.3 PROJECT OBJECTIVE AND APPROACH

The Corps of Engineers (COE), Fort Worth District, contracted with SCS Engineers to prepare conceptual closure/post-closure and contingency plans for each of the 31 selected sites at PBA. These plans will be included in the Part B permit application submittal to EPA for hazardous waste facilities. Run-on/runoff control plans were required for three of the hazardous waste facilities, which are currently used for storage of hazardous wastes.

In addition, this project was intended to provide the COE with preliminary design information and cost estimates. Final design specifications and associated costs will be developed at a later date under a separate contract.

The conceptual closure and post-closure plans were developed on the basis of site observations and information provided by PBA and COE staff. The project team visited each site, examined the data and documents provided by PBA and the COE, and identified and assessed alternatives available to effect site closure. These plans were developed to meet the requirements for site closure and partial requirements for post-closure, as mandated by RCRA. They represent the types of actions necessary to isolate the sites from the natural environment and to prevent migration of contaminants subsequent to closure. Assessment of the need for remedial action and ground water monitoring is beyond the scope of this work.

The closure/post-closure alternatives selected are those that, based on the available data, fulfill the requirements for site closure in a cost-effective manner. The plans have been completed in accordance with current professional standards. In many instances, the available data provide incomplete descriptions of site conditions; assumptions were thus made for the conceptual closure/post-closure plans. Some of the conceptual plans may be changed during the final design phase, depending on the results of subsequent subsurface investigations.

The conceptual closure/post-closure plans are presented in Section 3 of this report. General considerations common to a number of the plans are presented in Section 4. A hazardous waste contingency plan for PBA is presented in Section 5. The drawings associated with these closure plans are presented in a separately bound plan set. A waste compatibility chart for use in the operation of the proposed secure landfill is given in Appendix A.

TABLE 2-1. ACTIVE/ACTIVE SITES AT PBA

Site No.	Site Description	Page No.	
7a*	Old toxic storage yard	3-6	RCRA
11a	Sediment retention basin No. 1	3-13	
11b	Sediment retention basin No. 2	3-14	
11c	Sediment retention basin No. 3	3-18	
26	Drop tower test basin (standby)	3-24	
31b	Grenade test basin (standby)	3-25	RCRA
35	North oxidation pond	3-31	
36	Industrial sludge lagoons (2 each)	3-32	RCRA
40	Incinerator complex	3-38	
42	Water treatment backwash pond	3-39	
43	White phosphorus pollution abatement facility	3-45	

* Requires run-on/runoff control plan.

TABLE 2-2. ACTIVE/INACTIVE SITES AT PBA

Site No.	Site Description	Page No.
7b	Lewisite disposal area	3-46
7c	Mustard agent burning yard	3-52
7d	Toxic storage yard borrow pits (400 x 50 ft) (2 each)	3-53
10*	West bombing mat and waste storage yard	3-61
17	Product assurance test range and dump site	3-68
20a*	Depot south burning pit	3-73
23a	White smoke test pond	3-76
24	Thermite disposal area	3-83
27	Agent BZ pond	3-85

* Requires run-on/runoff control plan.

TABLE 2-3. INACTIVE/INACTIVE SITES AT PBA

Site No.	Site Description	Page No.
2	Webster Road test site	3-89
4a	504th Street burning ground	3-92
12	Old mustard dump site	3-96
13a	McCoy Road burning site	3-102
16a	White phosphorus settling pond and landfill	3-105
20b	White phosphorus slag burning and disposal area	3-109
29	Solid waste Arkla site	3-112
29a	Salt pile	3-113
31a	Product assurance test range (goat shed)	3-116
34	NCTR equalization pond	3-120
38	Impregnite sludge lagoon	3-123

SECTION 3

DEVELOPMENT OF CONCEPTUAL CLOSURE AND POST-CLOSURE PLANS

3.1 OVERVIEW OF SITE CLOSURE

The purpose of a conceptual closure plan is to provide adequate planning and technical information to guide a facility owner/operator toward proper facility closure. The ultimate objective of closure is to minimize the threats to human health and the environment resulting from use of the facility. Factors that must be considered in developing a closure plan include:

- Physical nature of the individual facility.
- Characteristics of the site, particularly with regard to existing waste types and contaminant migration pathways.

Site-specific considerations will dominate most closure plans. However, since the formal plan will provide the EPA Regional Administrator with the means to evaluate the suitability of the proposed closure action, it needs to include a step-by-step procedure for implementing closure, based on facility and site conditions.

Additionally, under current interim standards (EPA, 40 CFR 265.112(a)), all closure plans must include "(1) a description of how and when the facility will be partially closed, if applicable, and ultimately closed, including an estimate of the maximum extent of the operation which will be open at any point during the life of the facility; (2) an estimate of the maximum inventory of wastes in storage or treatment at any time; (3) a description of steps necessary to decontaminate the facility or render it non-hazardous at closure; and (4) a schedule for final closure activities."[2] Closure plans for facilities under interim status will of necessity be developed differently than those for new facilities, since the design, operation, and recordkeeping requirements of RCRA were not applicable when the interim status facilities were constructed.

Basically, site closure involves implementation of one or both of the following basic options:

- Hazardous materials will either be removed or rendered harmless, and no hazardous wastes will remain at the site.

- Construction or installation of features will be completed to isolate the facility and/or to prevent movement of any hazardous materials remaining at the site to adjacent property.

If any hazardous material remains at the site subsequent to closure, a post-closure plan must be developed. The major components of a post-closure plan are:

- A program to monitor ground and surface water quality and other environmental conditions.
- Periodic maintenance of both the facility containment systems and the monitoring system.

Under prevailing standards, the post-closure plan must provide for reasonable and/or foreseeable maintenance needs to protect the integrity of the site and to minimize the risk of environmental contamination during the period after facility closure.

3.2. DATA SOURCES AND PREVIOUS INVESTIGATIONS

All of the PBA sites studied existed prior to issuance of RCRA regulations. A number of these facilities were in use before the Korean conflict. Thus, data available for the majority of these facilities are limited. As a consequence, some of the data required of a closure plan are not presently available for these sites. For many sites, it is necessary to estimate the following items:

- Areal extent of past operations.
- Extent of contaminated soil.
- Types and quantities of wastes deposited.
- Waste characteristics as placed and at present.
- Specific closure schedules.
- Partial closure.

Development of final design plans and specifications for each specific site requires a thorough understanding of the site's subsurface and hydrogeologic conditions, in addition to the items listed above. Previous investigations at PBA have been oriented to develop background data at a number of the older uncontrolled hazardous waste disposal/storage sites and/or product testing sites. These investigations have involved shallow borings and chemical analyses of the soil samples obtained from the borings for the purpose of delineating contaminated soil zones.

The soil types encountered and the depth to ground water (if encountered) in these borings were not documented. The borings, made over a period of years, were generally located concentrically around areas known or suspected to be contaminated by disposed materials or storage activities. If the results appeared indicative of contamination, additional borings were made to further define the limits of contamination. Most of these borings

penetrated to a uniform depth of approximately 12 feet, although some selected borings were as much as 30 feet deep. Several samples obtained from each boring were analyzed for total concentrations of various potential contaminants. Results of these investigations have been published in Technical Memorandum No. 14.[3]

During the period from 1977 to 1978, a series of monitoring wells was installed around the PBA perimeter and at other specific locations, in conjunction with the installation restoration survey.[4] It was concluded that the potential exists at PBA for vertical migration of contaminants to the water table and the subsequent easterly movement of these contaminants off site.

Preliminary assessments of each of the 31 sites were made by AEHA in 1980.[1] At that time, grab samples of soil, sludge, and water were obtained from some of the sites. Analyses were then conducted in accordance with EP toxicity procedures established by the EPA to determine (1) the nature of the waste material, and (2) whether or not the wastes were hazardous.

During 1981, 53 ground water monitoring wells were installed at 15 of the 31 sites. The locations of these wells were selected based on available data. Logs were prepared by COE geologists for each well, based on visual descriptions of the cuttings brought up by the auger as the boring was advanced. These well logs thus represent generalized stratigraphic information. Consequently, the site-specific geologic/geotechnical data necessary for the final design of the closure plans for the 31 sites are limited.

The COE has developed generalized geologic descriptions and, in some cases, preliminary subsurface profiles for selected sites. These are based on logs of the recently installed monitoring wells and other available data. These descriptions and profiles are presented in Appendix B.

Another data source available for use in developing the conceptual closure plans consists of field observations made during inspection of the sites at the outset of this project. During the Fall of 1981, each site was surveyed by an SCS team comprised of a civil engineer and a geologist. The site visit followed a period of relatively heavy rain. The precipitation prior to and during the site visit was from a moderate storm for the area; it did not cause significant flooding or follow an unusually wet summer. Thus, the inspection team visited PBA at a time when it was possible to view each of the site's drainage characteristics during and immediately subsequent to a relatively normal precipitation event.

The inspection team examined each site, noting and/or photographing pertinent features and discussing each site with PBA personnel. Particular attention was given to key features such as drainage characteristics, presence or absence of ponded water and/or springs and seeps, type of vegetation in the vicinity of

the site, presence or absence of distressed vegetation, presence or absence of "dead" areas, and outcrops (natural or man-made) exposing the subsoils. Although such observations are largely subjective and limited to near-surface or surficial features, they provide valuable input to experienced personnel.

3.3 SITE CLOSURE TECHNOLOGY

The closure options available for the 31 facilities at PBA are relatively straightforward. They involve either (1) removal of the hazardous waste and contaminated materials to an approved hazardous waste landfill, or (2) containment of the waste and/or contaminated materials on site (in situ closure). A secure hazardous waste landfill is planned for development at PBA. An incinerator complex, used for destruction of certain chemical wastes, has recently been constructed. However, use of these facilities is not practical as part of the closure options for many of the 31 sites due to the relatively large volume and/or nature of the wastes and associated contaminated zones.

Thus, many of the sites will require in situ closure. The types of environmental controls suitable for consideration during development of a closure plan include most, if not all, of the features incorporated into the design of new facilities according to RCRA regulations. These environmental control features are intended to isolate the hazardous wastes or contaminated materials from the environment. They include modifications to site topography, surface drainage, and, in some cases, subsurface drainage.

Surficial controls include site grading to enhance runoff and prevent run-on; placement of impervious cover to minimize surface water infiltration; construction of dikes to prevent flooding; and temporary features such as sedimentation basins to prevent siltation and dispersal of contaminants during construction.

Subsurface controls include the construction of liners, drains, leachate collection systems, and hydraulic barriers. It should be noted that such subsurface features are considerably more difficult and expensive to install than surficial features at older uncontrolled sites.

In the more favorable cases, implementation of surficial features will provide adequate stabilization of a site to prevent contaminant movement. However, if a site is underlain by shallow ground water (even a seasonal or perched water table), surficial features may not be adequate to stabilize the site with regard to contaminant movement. In these cases, modification of the ground water flow pattern at a site may be a necessary part of a proper closure plan. Due to the relatively high expense of installing subterranean environmental control features, their requirement must be carefully evaluated and their design predicated on detailed subsurface information and environmental risks.

In closing large, uncontrolled disposal sites, for instance, it is generally impractical to provide them with an impervious liner and/or leachate collection system. However, it may be possible to minimize contact between the deposited wastes (or contaminated zone) and ground water by using drains to prevent/reduce underflow, or by installing hydraulic barriers to divert ground water or to contain leachate-contaminated ground water.

3.4 ASSUMPTIONS/CRITERIA

Development of the 31 closure/post-closure plans required that certain assumptions be made and that certain design criteria be treated uniformly. Site specific assumptions and criteria are discussed in the text or noted on the drawings. Most of the earthwork structures are based on standard designs; many are derived from Seelye.[5]

Assumptions/criteria of a general nature include the following:

- All channels were sized using the Standard Rational Method ($Q = CiA$), where Q = runoff in cubic feet per second; C = the coefficient of runoff; i = the rate of rainfall in inches per hour; and A = the drainage area in acres. The value used for i was 3.7 inches per hour, the 100-year, 1-hour peak intensity event. The exception is at Site 10 where the diversion channel was based on the existing drainage way.

- If a channel had flows of 2 feet per second or greater under normal conditions, it was provided with riprap. Where necessary, riprap was also used to stabilize channels against migration/erosion.

- For estimating purposes, ponds/impoundments with unknown bottom elevations were assumed to be 3 feet deep.

- It was assumed that sludge and sediments remaining in impoundments after dewatering would be in a workable condition, and capable of supporting cover or other fill placed over them.

- Wastewater transportation costs assume the use of tank trucks, except at Site 23a where the wastewater can be pumped into a nearby industrial sewer.

- Excavation quantities and costs are based on 2:1 side slopes without extensive dewatering.

- Unit costs for construction at the 31 sites varied according to the size of the proposed project and anticipated safety requirements. Unit costs for medium-sized projects were based on standard published data. Unit costs for large-volume work were decreased by 15 percent,

whereas those for small-volume work were increased by 25 percent. Unit costs were increased by 30 percent if it appeared likely that protective gear or elaborate safety measures would be required.

- Excavation of hazardous materials, particularly contaminated soils, is required at many of the sites. Available data on these soils indicated that the hazardous contaminants were analyzed and expressed in terms of total concentration, since the EP toxicity procedure was not then available. It was assumed that when the total concentration of contaminants was exceedingly high, and the contaminants were pervasive (suggesting gross contamination of the area), their removal/isolation was recommended.

- When the explorations documenting the depth of contaminated soils did not fully penetrate the contaminated zone, an additional 3 feet of excavation below the depth of exploration was assumed to be necessary.

- Minor cost items were not specified, but are included under contingencies.

- All descriptions of the sites, subsurface conditions, degree of contamination, and other characteristics are based on TM-14[3], AEHA Report D-1620-S[1], and site observations by SCS staff. Logs and field notes of the recently installed monitoring wells were examined as they became available during the course of this study.

- The geologic descriptions and profiles presented in Appendix B were prepared entirely by the COE, Fort Worth District, for use in this report.

3.5 CLOSURE AND POST-CLOSURE PLANS

3.5.1 Site 7a, Old Toxic Storage Yard

The old toxic storage yard (TSY) is a 48-acre, fenced yard presently used for storage of pesticides. An inventory of the materials stored at this facility as of 1980 is presented in Appendix D.

The old TSY appears to be underlain by stratified sands and clays with relatively complex hydrogeologic conditions. This site is likely characterized by multiple saturated sand zones separated by clay layers (see Appendix B). Locally, the ground water is shallow to very shallow, at least on a seasonal basis. During site reconnaissance, springs were observed on the south and east perimeters of the site. These springs occurred within 3 feet of the TSY surface. This site requires a run-on/runoff control plan and a closure/post-closure plan.

3.5.1.1 Assumptions

The major assumptions inherent in the run-on/runoff control and closure/post-closure plans are:

- Hazardous materials (i.e., contaminated soils) will remain after closure.
- Subsurface drainage in the perched (possibly seasonal) water table beneath the site is constrained by site stratigraphy to a shallow depth, and is primarily towards the south and east (as evidenced by springs and seeps observed during site reconnaissance).
- Recharge to the shallow perched zone extends beyond the confines of the site, resulting in the need for upgradient subterranean closure features to provide site isolation. (This assumption warrants detailed evaluation during the investigations required for final design of the closure plan.)

3.5.1.2 Run-on/Runoff Control Plan

The surface drainage originating at the TSY presently drains radially from the yard and enters the creek tributary to the Arkansas River. The COE is currently developing a project to collect contaminated and/or potentially contaminated surface drainage from the TSY and the production areas to the west. This water will be diverted into impermeable settlement/retention basin(s).

Since the TSY is entirely within this collection/retention system, separate run-on/runoff control is, in some respects, redundant. However, considering the soluble nature of some of the materials stored at the site and the ramifications of a major spill, it appears desirable to limit the area that could be affected by such an occurrence.

Features of the proposed plan include:

1. Construct berms to prevent run-on.
2. Install interceptor drains in areas where springs and seeps were observed, and collect the water in an impervious basin.
3. Install lined ditches and impervious berms to collect and channel runoff originating within the TSY.
4. Construct a retention basin provided with an impervious liner for storage of TSY runoff.

The retention basin can be monitored and discharged to the creek or transported to the PBA pollutation abatement facility for

treatment, as required. Lined ditches are required to transport runoff due to the water-soluble nature of the materials stored at the old TSY. If the ditches were unlined and runoff were contaminated by soluble materials, ground water contamination could result.

Conceptual drawings of the proposed run-on/runoff control features are presented on Sheet 3. Itemized construction cost estimates are presented in Table 3-1.

3.5.1.3 Closure Considerations

The most likely contaminant transport route away from the TSY appears to be by surface runoff or through the shallow or perched ground water beneath the site. Implementation of the proposed run-on/runoff plan may benefit the ground water table beneath the TSY by reducing recharge to the surficial aquifer(s) and collecting seepage discharging around its periphery. If this aquifer were effectively dewatered by elimination of recharge, and if the contaminated soils are not excessively deep (i.e., do not penetrate to a lower water-bearing zone), the potential for contaminant migration from the TSY would be minimal.

The actual effectiveness of the proposed run-on/runoff control system in reducing recharge cannot be accurately estimated at the present time. Thus, an upgradient hydraulic barrier or additional drains may be necessary to provide effective isolation of the TSY.

Assuming that the run-on/runoff control plan is fully implemented, the following additional steps will be required to close the TSY:

1. Decontaminate and raze existing warehouse and storage facilities.

2. Install impervious cover sloped to provide rapid runoff.

3. Construct a hydraulic barrier immediately upgradient from the facility. (The necessity of this feature will need to be determined during final design.)

4. Maintain all features of the run-on/runoff control system.

5. Maintain existing security measures.

6. Prepare and record a plot plan of the closed site, using the existing fence in lieu of monuments.

The major features of this plan are shown on Sheet 5, and cost estimates for its implementation are presented in Table 3-2. A proposed implementation schedule is presented in Figure 3-1.

TABLE 3-1. SITE 7A COST ESTIMATE FOR IMPLEMENTATION OF PROPOSED RUN-ON/RUNOFF CONTROL SYSTEM

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation	42,520 m^3	2.50/m^3	106,300
Trenching	1,550 m^3	3.83/m^3	5,935
Clearing and Grubbing	4.0 acres	1,100/acre	4,400
Berms/Levees	14,090 m^3	5.00/m^3	70,450
Swale/Channel	1,470 m	3.50/m	5,145
4" PVC Pipe	1,400 m	5.45/m	7,630
Curb and Gutter	375 m	37.57/m	14,090
Gravel	6,750 m^3	8.00/m^3	54,000
Sand	6,885 m^3	8.50/m^3	58,525
Clay Liner from On-Site	9,180 m^3	5.00/m^3	45,900
Low-Permeability Flow	3,510 m^3	3.00/m^3	10,530
36-mil Reinforced Hypalon Sheeting	15,530 m^2	5.95/m^2	92,405
Fencing	615 m	40.00/m	24,600
Culvert Pipe - 36" dia	34 m	118.00/m	4,010
Culvert Pipe - 18" dia	7 m	35.30/m	250
Leachate Sump and Piping	1	750/each	750
Bituminous Asphalt - 2" thick min	8,250 m^2	4.80/m^2	39,600
Pavement Sealing	8,100 m^2	0.78/m^2	6,320
Revegetation	11,245 m^2	1.25/m^2	14,055
Topsoil	1,850 m^3	3.00/m^3	5,550
Subtotal			570,445
Engineering/Permit Fee (15% of Subtotal)			85,565
Contingencies (20% of Subtotal)			114,090
Total (1982 dollars)			770,100
Total (1983 dollars)*			847,110
Total (1984 dollars)*			931,820

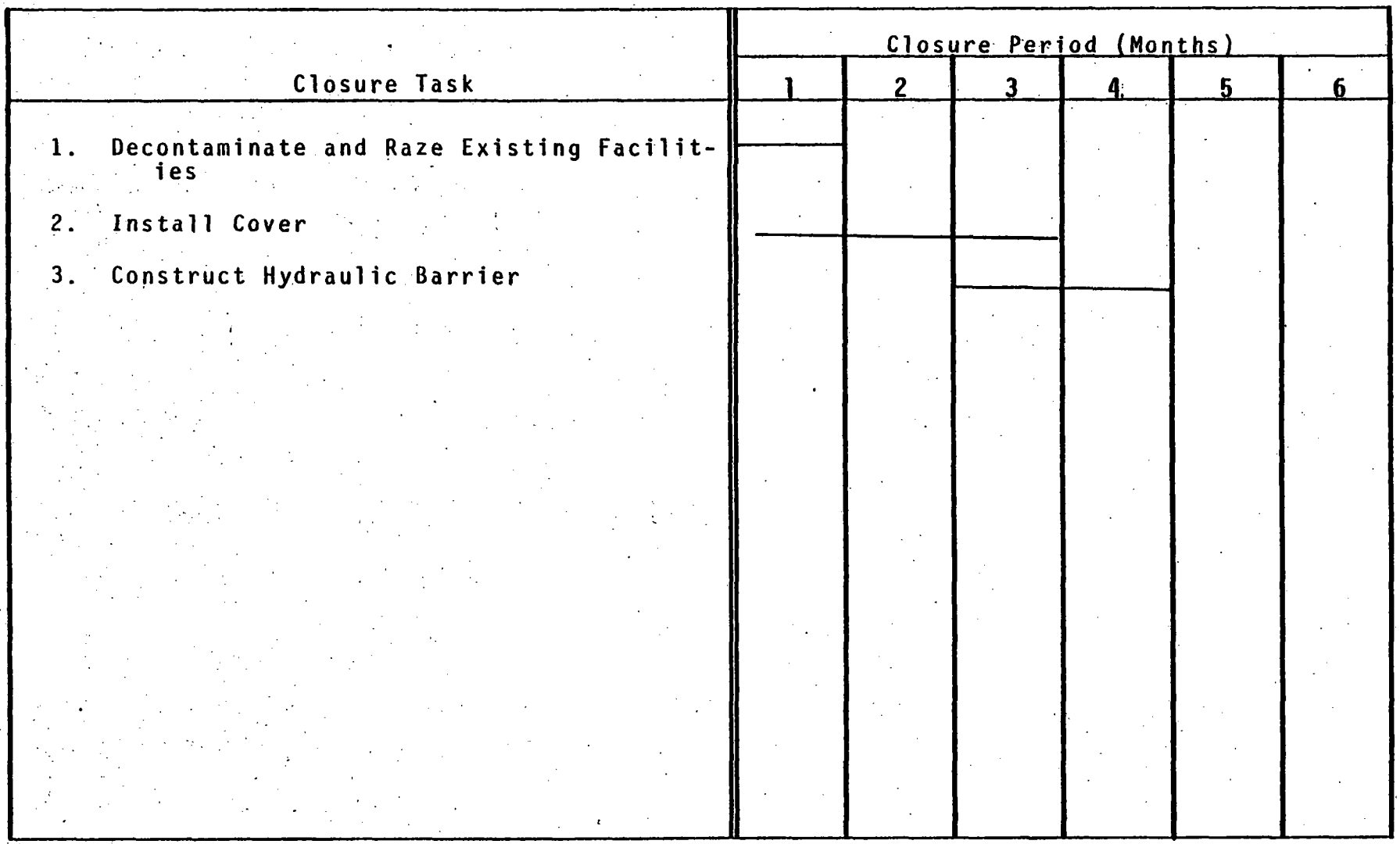
* Calculated at 10 percent per year inflation.

TABLE 3-2. SITE 7A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Ordinary Fill	46,650 m^3	2.55/m^3	118,960
Low-Permeability Fill	119,080 m^3	2.55/m^3	303,655
Revegetation	195,939 m^2	1.06/m^2	207,700
Topsoil	59,540 m^3	2.55/m^3	151,830
Subtotal			782,145
Engineering/Permit Fee (15% of Subtotal)			117,320
Contingencies (20% of Subtotal)			156,430
Total (1982 dollars)			1,055,895
Total (1983 dollars)*			1,161,485
Total (1984 dollars)*			1,277,635

* Calculated at an inflation rate of 10 percent per year.

Figure 3-1. Site 7a, proposed closure implementation schedule.



3.5.1.4 Post-Closure Care

Monitoring the closed TSY should be relatively straightforward. Post-closure care will primarily involve periodic inspection of the site and occasional maintenance of vegetation, surface seal, run-on/runoff control structures, and hydraulic barrier. A ground water monitoring system has been installed, and a monitoring plan has been developed for the facility and adjacent areas. Considering the nature of the site, the anticipated level of maintenance should be minimal. Monitoring the piezometric level beneath the closed site will likely provide the best means of detecting deterioration, if any, of the relevant environmental control systems. Thus, the piezometer/observation well net established during the site investigation should be maintained and monitored throughout the closure period.

During the first 2 years following closure of the site, inspections should be made quarterly. In subsequent years, annual inspections should be made. An inspection form is presented in Table 4-1. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $20,000 (1984 dollars).

3.5.1.5 Additional Investigations

The conceptual run-on/runoff control plans for Site 7a are based on a limited understanding of the site's subsurface and hydrogeologic conditions. Likewise, the extent of contaminated soil and/or ground water resulting from past site operations is unknown. To determine the suitability of the proposed closure plan, it will be necessary to conduct detailed investigations to delineate the site's actual subsurface conditions. We recommend that such an investigation be completed prior to final design of the site closure features. If appropriate, the preliminary plans presented herein should be modified to reflect actual site conditions.

The investigation should consist of exploratory borings and test pits which reveal potential contaminant pathways. It should also include the installation of a number of monitoring wells and piezometers to delineate and permit assessment of both the horizontal and vertical ground water flow patterns in the complex aquifer system beneath the site.

We recommend that this investigation be completed at the earliest opportunity so that the effects of implementing the run-on/runoff control plan can be properly monitored. Such monitoring will be a cost-effective means of determining the need for the proposed upgradient hydraulic barrier or drains and other closure features.

3.5.2 Site 11a, Sediment Retention Basin (SRB) No. 1

SRB No. 1 is used to capture runoff and DDT-contaminated sediments from production areas. It is located approximately 2,000 feet west of Site 7a, and is the first in a series of two retention basins. This impoundment consists of an earthen berm with a metal overflow structure across an apparently natural drainage way. The retention basin is not lined. The site is underlain by stratified sands and clays, with ground water found at a depth of 8 to 10 feet (see Appendix B). This site requires a closure/ post-closure plan.

3.5.2.1 Assumptions

Development of the closure/post-closure plan requires that a number of assumptions be made. These include:

- The sediments retained in the basin are a hazardous waste.
- The basin became lined with fine sediments during its first few months of operation. Consequently, extensive zones of contaminated soil are not present, and percolation through these sediments is restricted.
- Closure of this site will not require the construction of a temporary SRB downstream, since Site 11b should serve this purpose.

3.5.2.2 Closure Considerations

Closure of Site 11a involves the following actions:

1. Divert/relocate the influent stream. (This channel should be lined if it passes through sandy soils in order to reduce infiltration in the vicinity of the site.)
2. Drain the impoundment.
3. Grub the side slopes of the impoundment.
4. Demolish and crush the overflow structure, and place it in the impoundment for burial.
5. Backfill the impoundment with compacted, low-permeability soil, and crown the surface to enhance runoff and reduce infiltration.
6. Backfill the discontinued portions of the stream with compacted silty clay soil to prevent surface water ponding.

7. Construct peripheral drainage ditches and/or berms to prevent run-on and enhance runoff.

8. Place topsoil and revegetate all disturbed areas.

9. Place monuments to define the location of the closed impoundment (which will still contain hazardous materials).

Closure activities should be scheduled for the drier season to reduce construction problems and dispersion of impoundment sludge downstream. The closed site is shown on Sheet 6, and estimated closure costs are presented in Table 3-3. A proposed implementation schedule is presented as Figure 3-2.

3.5.2.3 Post-Closure Care

Post-closure care of the SRB will parallel that required for a hazardous waste landfill. Ground water monitoring will be necessary; a monitoring system and plan have been implemented.

The site should be inspected for erosion or other damage annually for 3 years, and biannually thereafter. An inspection form is presented in Table 4-1. It is anticipated that little, if any, maintenance will be required at this site, since very little settlement should occur. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $700 (1984 dollars).

3.5.2.4 Additional Investigations

The proposed closure concept is based on the assumption that the basin behaves like a lined impoundment. It is important to confirm this assumption. Thus, prior to final design of the closure features, we recommend that additional investigations be completed to identify potential contaminant pathways and to determine whether or not the sludge/sediment is sufficiently impervious to act as a liner. If not, this plan should be reevaluated and modified as appropriate.

3.5.3 Site 11b, SRB No. 2

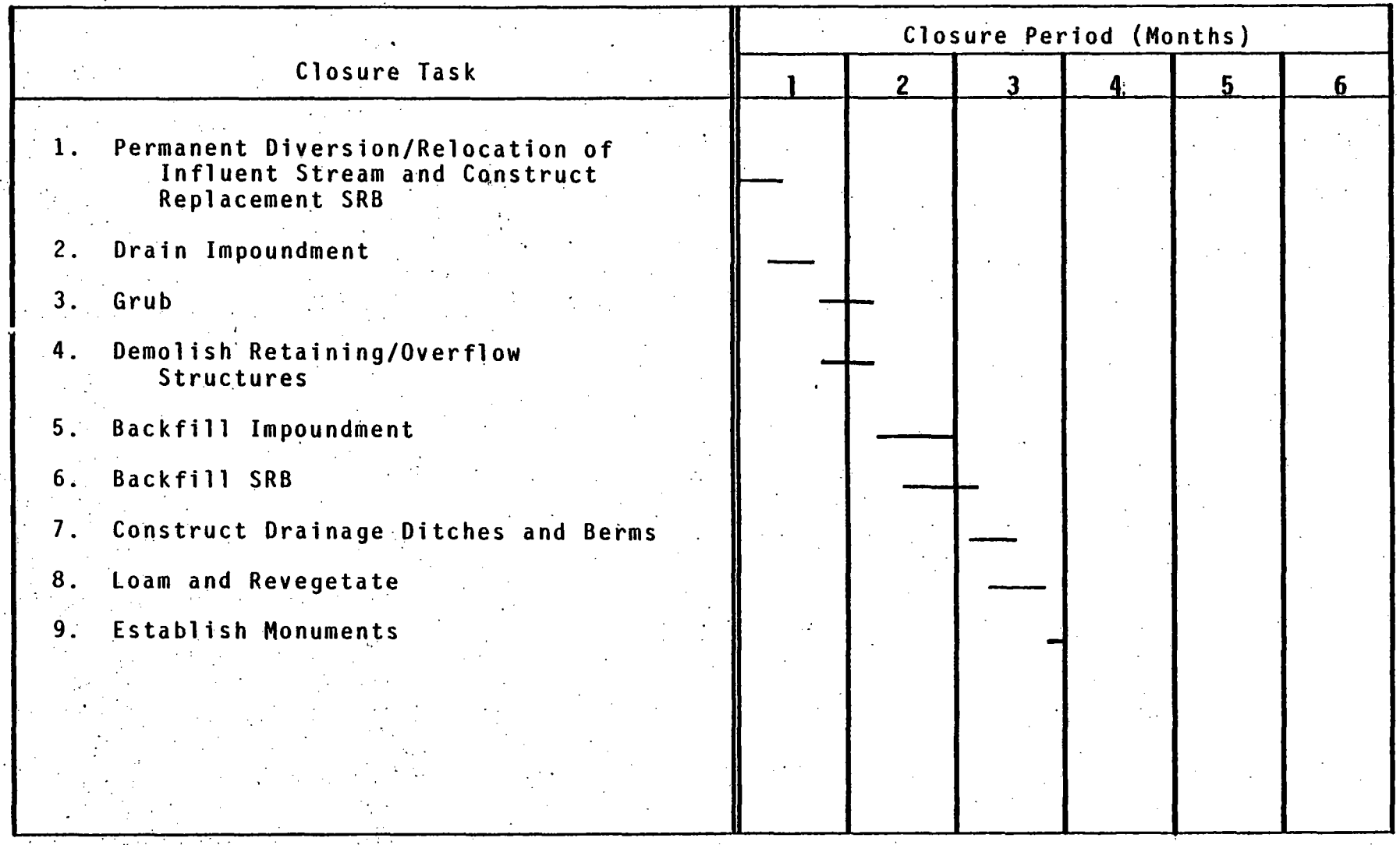
SRB No. 2 is also used to capture runoff and DDT-contaminated sediments from production areas. It is located downstream from Site 11a, approximately 2,000 feet west of Site 7a, and is the second in a series of two retention basins. This impoundment consists of an earthen berm with a metal overflow structure across an apparently natural drainage way. The retention basin is not lined. The site is underlain by stratified sands and clays with ground water found at a depth of 8 to 10 feet (see Appendix B). This site requires a closure/ post-closure plan.

TABLE 3-3. SITE 11A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	1,620 m^2	0.34/m^2	550
Excavation	800 m^3	3.13/m^3	2,505
Low-Permeability Fill	1,270 m^3	3.75m^3	4,765
Swale/Channel	390 m	4.38/m	1,710
Revegetation	280 m^2	1.56/m^2	435
Topsoil	860 m^3	3.75/m^3	3,225
Subtotal			13,190
Engineering/Permit Fee (15% of Subtotal)			1,980
Contingencies (20% of Subtotal)			2,640
Total (1982 dollars)			17,810
Total (1983 dollars)*			19,590
Total (1984 dollars)*			21,550

* Calculated at an inflation rate of 10 percent per year.

Figure 3-2. Site 11a, proposed closure implementation schedule.



3.5.3.1 Assumptions

Development of the closure/post-closure plan requires that a number of assumptions be made. These include:

- The sediments retained in the basin are a hazardous waste.
- The basin became lined with fine sediments during its first few months of operation. Consequently, extensive zones of contaminated soil are not present, and percolation through these sediments is restricted.

3.5.3.2 Closure Considerations

Closure of Site 11b involves the following actions:

1. Divert/relocate the influent stream. (This channel should be lined if it passes through sandy soils in order to reduce infiltration in the vicinity of the site.)
2. Construct a temporary SRB downstream to contain sediment during construction and until revegetation is accomplished.
3. Drain the impoundment.
4. Grub the side slopes of the impoundment.
5. Demolish and crush the overflow structure, and place it in the impoundment for burial.
6. Backfill the impoundment with compacted, low-permeability soil, and crown the surface to enhance runoff and reduce infiltration.
7. Backfill the discontinued portions of the stream with compacted silty clay soil to prevent surface water ponding.
8. Construct peripheral drainage ditches and/or berms to prevent run-on and enhance runoff.
9. Place topsoil and revegetate all disturbed areas.
10. Place monuments to define the location of the closed impoundment (which will still contain hazardous materials).
11. Clean up and demolish temporary SRB.

Closure activities should be scheduled for the drier season to reduce construction problems and dispersion of impoundment

sludge downstream. The closed site is shown on Sheet 6, and estimated closure costs are presented in Table 3-4. A proposed implementation schedule is presented as Figure 3-3.

3.5.3.3 Post-Closure Care

Post-closure care of the SRB will parallel that required for a hazardous waste landfill. Ground water monitoring will be necessary; a monitoring system and plan have been implemented.

The site should be inspected for erosion or other damage annually for 3 years, and biannually thereafter. An inspection form is presented as Table 4-1. It is anticipated that little, if any, maintenance will be required, since very little settlement should occur. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $1,000 (1984 dollars).

3.5.3.4 Additional Investigations

The proposed closure concept is based on the assumption that the basin behaves like a lined impoundment. It is important to confirm this assumption. Thus, prior to final design of the closure features, we recommend that additional investigations be completed to identify potential contaminant pathways and to determine whether or not the sludge/sediment is sufficiently impervious to act as a liner. If not, this plan should be reevaluated and modified as appropriate.

3.5.4 Site 11c, SRB No. 3

SRB No. 3 is used to capture runoff and DDT-contaminated sediments from production areas. It is located immediately southwest of Site 7b, the Lewisite disposal area. This impoundment consists of an earthen berm with a metal overflow structure across an apparently natural drainage way. The retention basin is not lined. The site is underlain by stratified sands and clays, with ground water found at a depth of 8 to 10 feet (see Appendix B). This site requires a closure/post-closure plan.

3.5.4.1 Assumptions

Development of the closure/post-closure plan requires that a number of assumptions be made. These include:

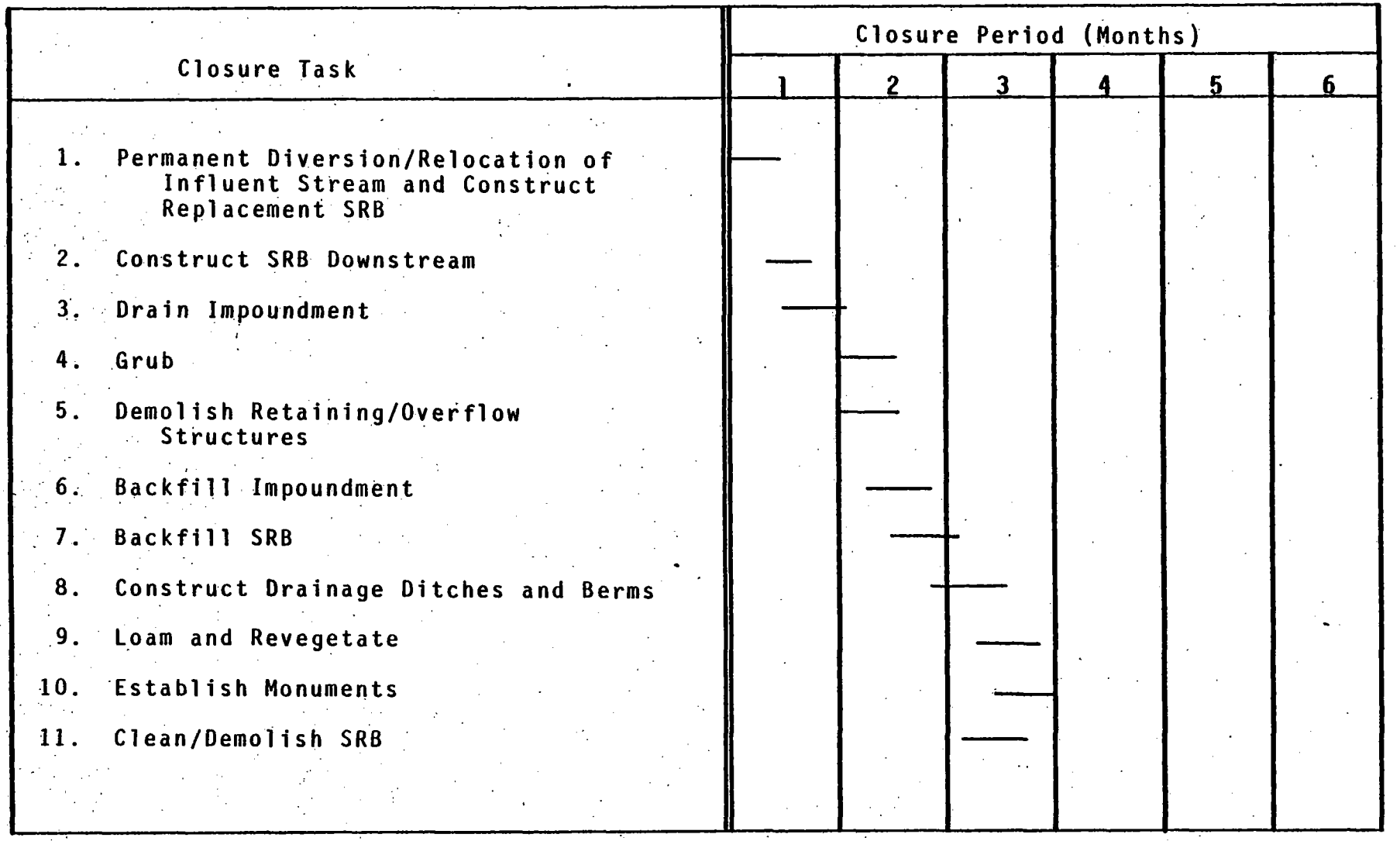
- The sediments retained in the basin are a hazardous waste.
- The basin became lined with fine sediments during its first few months of operation. Consequently, extensive zones of contaminated soil are not present, and percolation through these sediments is restricted.

TABLE 3-4. SITE 11B COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	1,220 m^2	0.34/m^2	415
Excavation	1,770 m^3	3.13/m^3	5,540
Low-Permeability Fill	1,870 m^3	3.75/m^3	7,015
Berms/Levees	15 m^3	6.25m^3	95
Swale/Channel	350 m	4.38/m	1,535
Revegetation	2,550 m^2	1.56/m^2	3,980
Topsoil	770 m^3	3.75/m^3	2,890
Subtotal			21,470
Engineering/Permit Fee (15% of Subtotal)			3,220
Contingencies (20% of Subtotal)			4,295
Total (1982 dollars)			28,985
Total (1983 dollars)*			31,885
Total (1984 dollars)*			35,070

* Calculated at an inflation rate of 10 percent per year.

Figure 3-3. Site 11b, proposed closure implementation schedule.



3.5.4.2 Closure Considerations

Closure of Site 11c involves the following actions:

1. Divert/relocate the influent stream. (This channel should be lined if it passes through sandy soils in order to reduce infiltration in the vicinity of the site.)

2. Construct a temporary SRB downstream to contain sediment during construction and until revegetation is accomplished.

3. Drain the impoundment.

4. Grub the side slopes of the impoundment.

5. Demolish and crush the overflow structure, and place it in the impoundment for burial.

6. Backfill the impoundment with compacted, low-permeability soil, and crown the surface to enhance runoff and reduce infiltration.

7. Backfill the discontinued portions of the stream with compacted silty clay soil to prevent surface water ponding.

8. Construct peripheral drainage ditches and/or berms to prevent run-on and enhance runoff.

9. Place topsoil and revegetate all disturbed areas.

10. Place monuments to define the location of the closed impoundment (which will still contain hazardous materials).

11. Clean up and demolish temporary SRB.

Closure activities should be scheduled for the drier season to reduce construction problems and dispersion of impoundment sludge downstream. The closed site is shown on Sheet 6, and estimated closure costs are presented in Table 3-5. A proposed implementation schedule is presented as Figure 3-4.

3.5.4.3 Post-Closure Care

Post-closure care of the SRB will parallel that required for a hazardous waste landfill. Ground water monitoring will be necessary; a monitoring system and plan have been implemented.

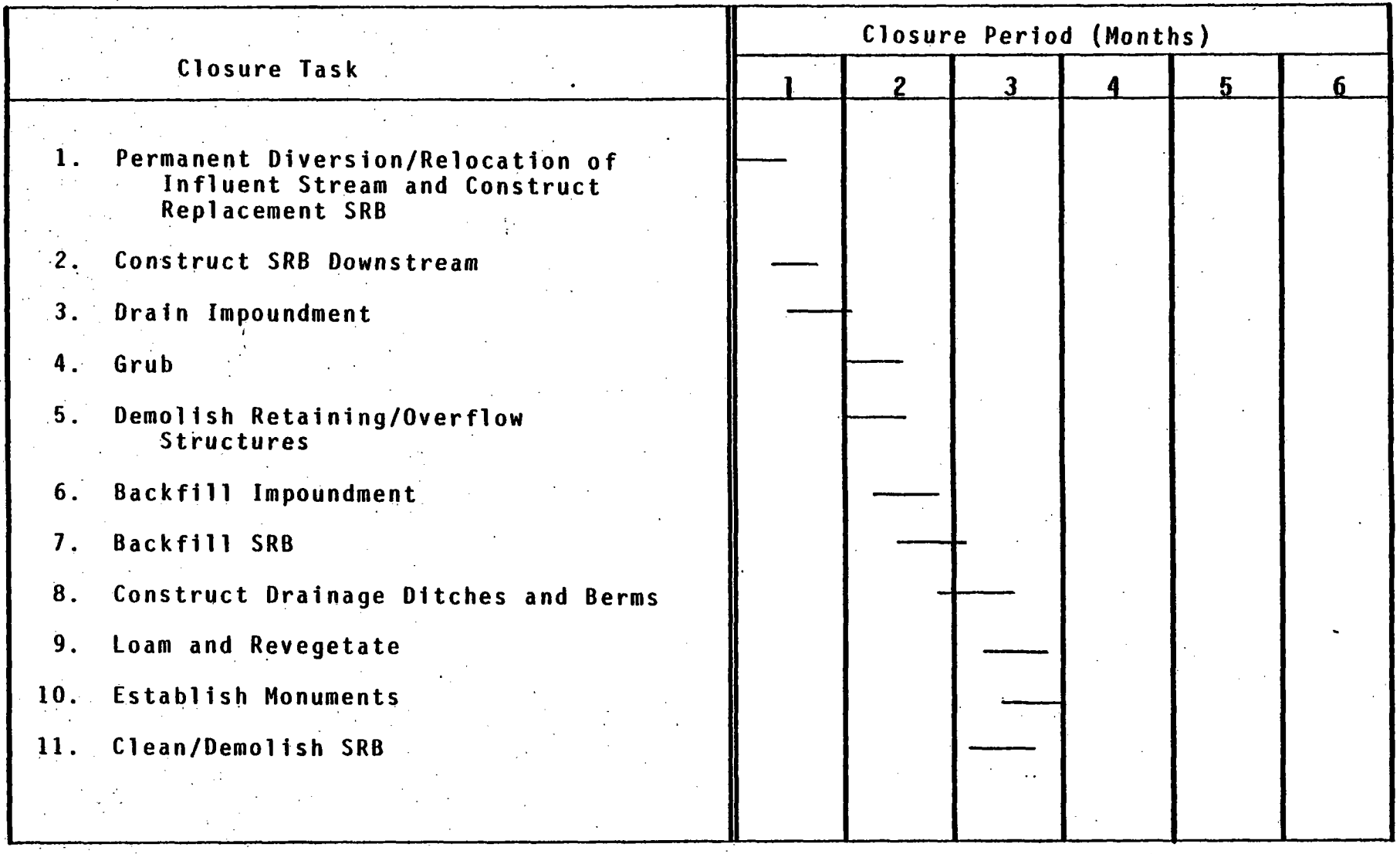
The site should be inspected for erosion or other damage annually for 3 years, and biannually thereafter. An inspection form is presented in Table 4-1. It is anticipated that little,

TABLE 3-5. SITE 11C COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	6,070 m^2	0.34/m^3	2,065
Excavation	1,300 m^3	3.13/m^3	4,070
Low-Permeability Fill	2,100 m^3	3.75/m^3	7,875
Berms/Levees	26 m^3	6.25/m^3	165
Swale/Channel	370 m	4.38/m	1,620
Revegetation	6,070 m^2	1.56/m^2	9,470
Topsoil	1,540 m^3	3.75/m^3	5,775
Subtotal			31,040
Engineering/Permit Fee (15% of Subtotal)			4,655
Contingencies (20% of Subtotal)			6,210
Total (1982 dollars)			41,905
Total (1983 dollars)*			46,095
Total (1984 dollars)*			50,705

* Calculated at an inflation rate of 10 percent per year.

Figure 3-4. Site 11c, proposed closure implementation schedule.



if any, maintenance will be required since very little settlement should occur. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $1,200 (1984 dollars).

3.5.4.4 Additional Investigations

The proposed closure concept is based on the assumption that the basin behaves like a lined impoundment. It is important to confirm this assumption. Thus, prior to final design of the closure features, it is recommended that additional investigations be completed to identify potential contaminant pathways and to determine whether or not the sludge/sediment is sufficiently impervious to act as a liner. If not, this plan should be reevaluated and modified as appropriate.

3.5.5 Site 26, Drop Tower Test Basin (Standby)

The drop tower test basin is a shallow, concrete-lined structure surrounding a grenade testing tower. This facility is used to test grenades as part of PBA's product quality assurance program. The basin is square, 30 feet in plan view, and reportedly 6 feet deep.

There are accumulations of spent grenades in the basin. The basin is emptied periodically, and the residue is placed in drums for ultimate disposal in PBA's proposed secure landfill. Precipitation falling in the basin drains to a sump, and is transported by an industrial sewer to PBA's pollution abatement facility. Some relatively restricted zones of contaminated soil peripheral to the site were identified by previous investigations. Anomalous concentrations of barium, lead, zinc, DDT, and dye were detected at shallow depths. The site is probably underlain by stratified clayey and sandy soils, and the depth to water table is unknown (see Appendix B).

3.5.5.1 Assumptions

The major assumption inherent in this plan is that contaminated soil zones are relatively restricted, because the site is diked and lined, and spent liquid is periodically drained.

3.5.5.2 Closure Considerations

Closure of the test basin will involve the following actions:

1. Remove and transport the residue remaining in the basin to the proposed secure landfill.

2. Demolish the basin and transport it to the sanitary landfill or proposed secure landfill for disposal (depending upon the degree of contamination found in the concrete).

3. Remove the contaminated soils found around the basin, and transport them to either the proposed secure landfill or the sanitary landfill (depending upon the severity of contamination).

4. Plug the discontinued sewer line.

5. Backfill all disturbed and/or excavated areas with compacted, low-permeability natural soil.

6. Place topsoil and revegetate.

The features of this closure plan are shown on Sheet 7, and estimated costs for its implementation are presented in Table 3-6. A proposed closure schedule is shown in Figure 3-5.

3.5.5.3 Post-Closure Care

Once the grenade residue has been removed and the closure plan implemented, no hazardous materials will remain at the site. Thus, long-term monitoring and maintenance will not be necessary. The success of the revegetation effort should, however, be observed in the late spring during the first 3 years following closure, and maintenance should be provided as appropriate.

3.5.5.4 Additional Investigations

Prior to final design of the features for closure of Site 26, it will be necessary to more accurately determine the extent and depth of contaminated soil resulting from overflow and/or spillage. The findings will define the actual area requiring excavation, and will determine if the contaminated soil can be placed in a sanitary landfill or must be disposed of in the proposed secure facility.

It will also be necessary to determine the nature and degree of contamination of the concrete basin. Previous investigations at the site show that of the 52 shallow holes drilled and analyzed for contamination at this site, only four encountered contaminant concentrations above critical threshold values. The distribution of the contaminated bores makes it difficult to accurately estimate the quantity of soil that will need to be excavated. Investigations to confirm that the contaminated soil has been fully excavated appear warranted. Thus, prior to backfilling excavated areas, several samples of the exposed soil should be taken and analyzed.

3.5.6 Site 31b, Grenade Test Basin (Standby)

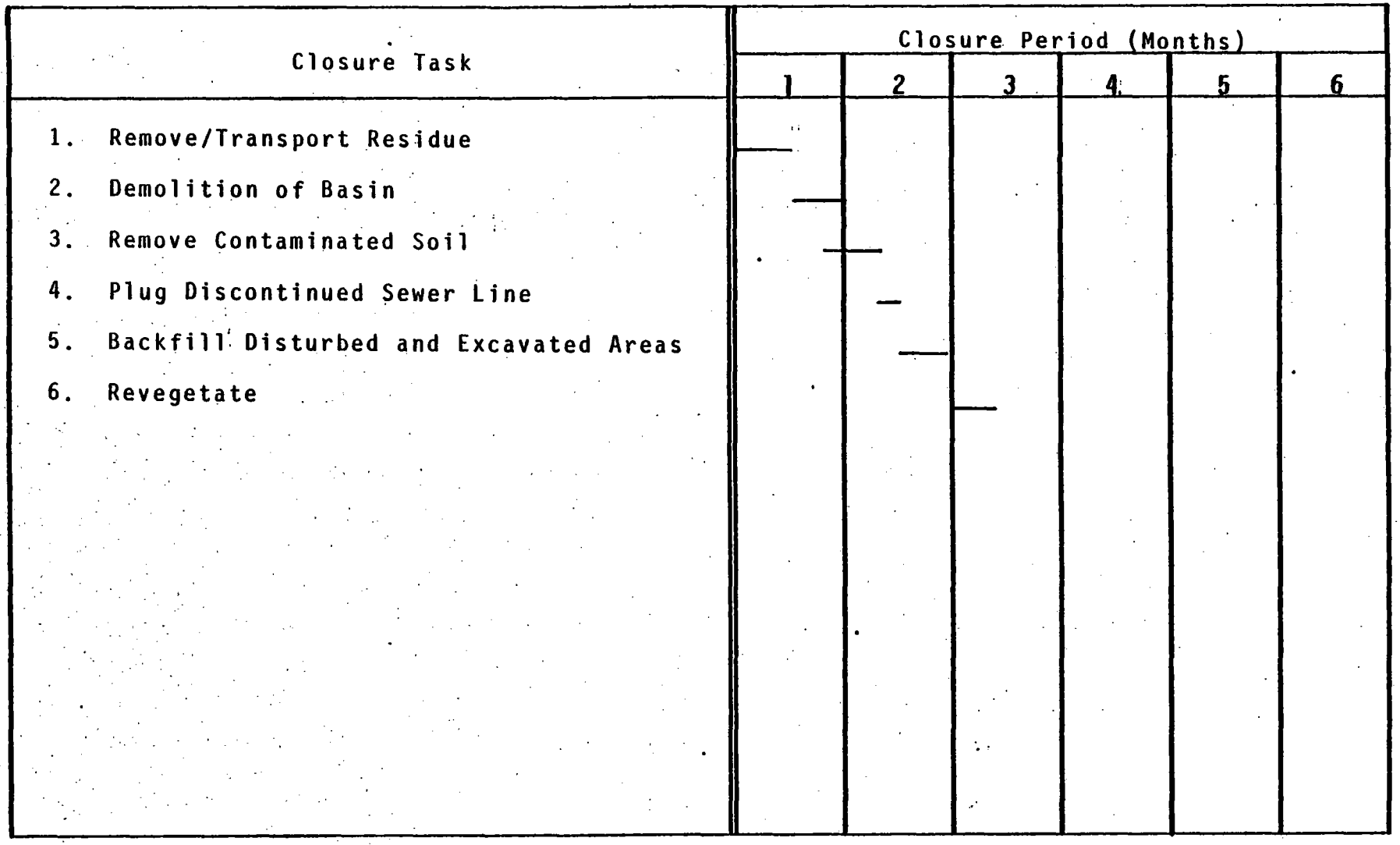
The standby grenade test basin, Site 31b, is very similar to Site 26, the drop tower test basin. This facility is located on the edge of a small pond. No investigation has been conducted to determine the presence or absence of contaminated soil at this

TABLE 3-6. SITE 26 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	8,100 m^2	0.27/m^2	2,185
Excavation of Contaminated Material	54,800 m^3	3.25/m^3	178,100
Low-Permeability Fill	51,370 m^3	3.00/m^3	154,110
Berms/Levees	30 m^3	5.00/m^3	150
Demolition, Concrete	80 m^3	7.07/m^3	565
Revegetation	8,100 m^2	1.25/m^2	10,125
Topsoil	3,430 m^3	3.00/m^3	10,290
Subtotal			355,525
Engineering/Permit Fee (15% of Subtotal)			53,330
Contingencies (20% of Subtotal)			71,105
Total (1982 dollars)			479,960
Total (1983 dollars)*			527,955
Total (1984 dollars)*			580,750

* Calculated at an inflation rate of 10 percent per year.

Figure 3-5. Site 26, proposed closure implementation schedule.



site. Precipitation falling into the basin drains into an industrial sewer and is transported to the pollution abatement facility. A generalized description of the site's geologic conditions is presented in Appendix B.

3.5.6.1 Assumptions

The primary assumptions are as follows:

- The site does not contain substantial volumes of contaminated soil.
- If such contaminated materials are present, the site's subsurface conditions are not suitable for in situ closure (due to its proximity to the pond and resultant shallow ground water table).
- Any required earthwork will take place over a short enough period that sediment control features will not be required.

3.5.6.2 Closure Considerations

Closure of this site will involve the following actions:

1. Place the remaining residue in drums and transport to the proposed secure landfill for disposal.
2. Plug the sewer line.
3. Demolish the basin and transport to the sanitary landfill or the proposed secure landfill for disposal, as appropriate.
4. Excavate contaminated soils, if any, and transport to the secure landfill or the sanitary landfill, as appropriate.
5. Backfill all disturbed/excavated areas with low-permeability soil, graded to promote runoff.
6. Cover with topsoil and revegetate the area.

The major features of the closed site are shown on Sheet 8, and estimated closure costs are shown in Table 3-7. A proposed implementation schedule is presented as Figure 3-6.

3.5.6.3 Post-Closure Care

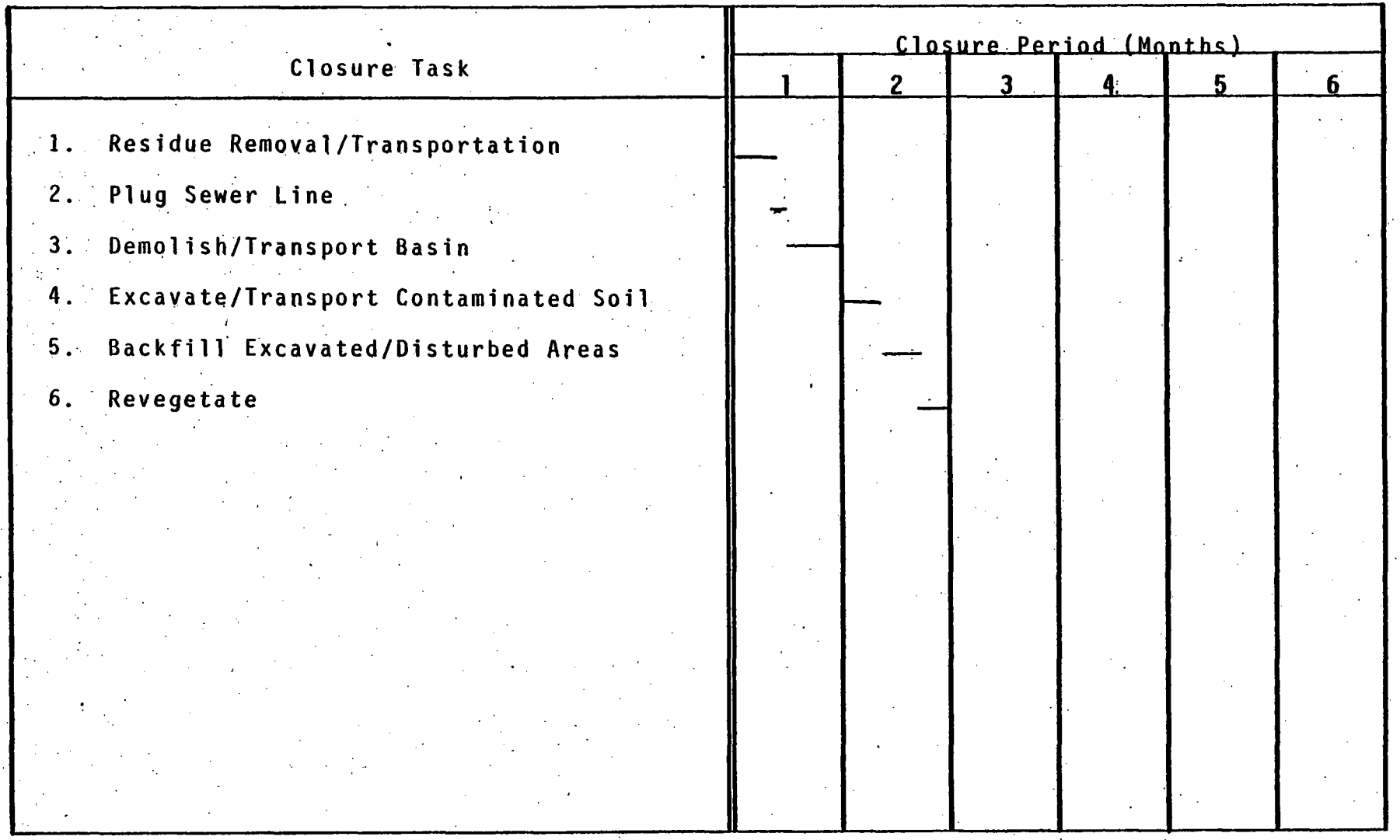
Post-closure care requirements for Site 31b will be minimal, since no hazardous materials will remain after closure. The site should be inspected annually for 3 years or until revegetation is successful. Maintenance, if necessary, should consist only of reseeding damaged areas.

TABLE 3-7. SITE 31B COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation of Contaminated Material	95 m^3	4.07/m^3	385
Low-Permeability Fill	95 m^3	3.75/m^3	355
Demolition, Concrete	45 m^3	8.84/m^3	400
Revegetation	150 m^2	1.56/m^2	235
Topsoil	155 m^3	3.75/m^3	580
Subtotal			1,955
Engineering/Permit Fee (15% of Subtotal)			295
Contingencies (20% of Subtotal)			390
Total (1982 dollars)			2,640
Total (1983 dollars)*			2,905
Total (1984 dollars)*			3,195

* Calculated at an inflation rate of 10 percent per year.

Figure 3-6. Site 31b, proposed closure implementation schedule.



3.5.6.4 Additional Investigations

Prior to final design, adequate site and subsurface investigations should be completed to define the depth and extent of contaminated soil at the site.

3.5.7 Site 35, North Oxidation Pond

Site 35 is a clay-lined, 19-acre lagoon used for treatment of domestic sewerage and industrial waste. This facility receives domestic sewerage from PBA, and a combination of domestic sewerage and industrial waste from the National Center for Toxicological Research. The site is probably underlain by stratified sandy and clayey soils. The general geologic characteristics of the site are described in Appendix B.

3.5.7.1 Assumptions

The north oxidation pond is classified as a hazardous waste surface impoundment, because it receives industrial waste in addition to domestic sewerage. The quantity and characteristics of the bottom sludge in the lagoon are unknown. It is assumed that whatever material exists in the lagoon at the time of closure is hazardous.

3.5.7.2 Closure Considerations

Closure of this impoundment will involve the following actions:

1. Decant fluid from the pond through the chlorine contact chamber; continue discharging so long as it meets the current discharge requirements. It is likely, however, that as the pond drains, turbidity will stir up sludge from the bottom of the lagoon, and the discharge will need to be transported to the PBA pollution abatement facility.

2. Construct temporary SRB's.

3. Allow the sludge to dry or mix with soils until it becomes workable. Push the sludge away from the central portions of the lagoon (out of the area that will become drainage swales), and down the sides of the lagoon embankment away from those areas where the embankment is to be breached (to provide egress for the drainage swales). The upper portions of the embankment can be used in conjunction with ordinary fill to rough-grade the interior of the lagoon in preparation for cover placement. The liner should remain undisturbed in any area overlain by sludge. The interior slopes of the regraded lagoon should not exceed 4 horizontal to 1 vertical.

4. Remove and demolish the outfall structure, and embed within the lagoon's interior embankments.

5. Cover the entire area underlain by sludge with 24 inches of compacted natural silty clays placed in three 8-inch (compacted thickness) lifts. This cover should be keyed into the lagoon liner.

6. Cover the clay seal and all disturbed areas with 12 inches of topsoil and revegetate.

7. Channelize the central drainage swales to promote rapid runoff and to protect against erosion.

8. Set monument(s) and prepare a plot plan to delineate the site's location.

The features of the proposed closure plan are shown on Sheet 9, and cost estimates for its implementation are presented in Table 3-8. A proposed closure schedule is presented in Figure 3-7.

3.5.7.3 Post-Closure Care

The post-closure care requirements for the north oxidation pond will parallel those for a hazardous waste landfill in that hazardous materials will remain after closure. A ground water monitoring system has recently been installed, and a monitoring plan developed for this facility.

Since substantial settlement of the final cover is not anticipated, annual inspections of the facility should suffice for the post-closure care period. An inspection form is provided in Table 4-1. Post-closure care should be minimal, and will consist of occasional repairs to the cover material, maintenance of the central and peripheral ditches, and revegetation, as required. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $12,000 (1984 dollars).

3.5.7.4 Additional Investigations

None.

3.5.8 Site 36, Industrial Sludge Lagoons

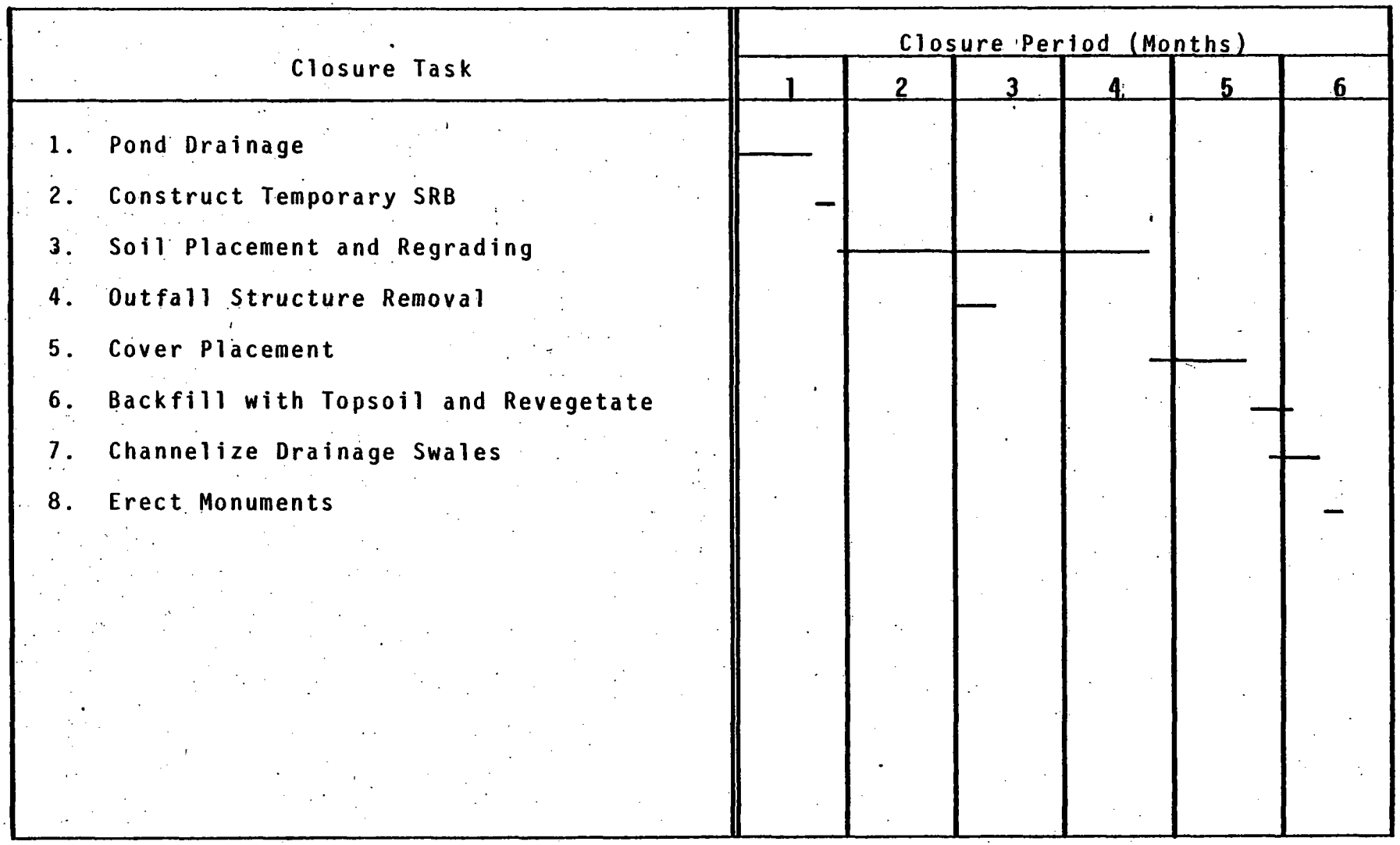
Site 36 consists of two lined 3-acre industrial sludge lagoons which receive waste from PBA production and test facilities. Analysis of the sludge indicates the presence of arsenic, barium, cadmium, chromium, lead, and mercury. The soil stratigraphy in this area is very similar to that at Sites 20a and 20b, consisting of Pleistocene terrace materials. The upper layers are primarily silty sands and lean clays. Ground water is

TABLE 3-8. SITE 35 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Earth Movement/Grading of Contaminated Material	460 m^3	2.77/m^3	1,275
Ordinary Fill	79,390 m^3	2.55/m^3	202,445
Low-Permeability Fill	50,760 m^3	2.55/m^3	129,440
Berms/Levees	50 m^3	4.25/m^3	215
Swale/Channel	590 m	2.98/m	1,760
Wastewater Removal/Treatment	24,220 m^3	6.18 m^3	149,710
Revegetation	79,350 m^2	1.06/m^2	84,110
Topsoil	25,380 m^3	2.55/m^3	64,720
Subtotal			633,675
Engineering/Permit Fee (15% of Subtotal)			95,050
Contingencies (20% of Subtotal)			126,735
Total (1982 dollars)			855,460
Total (1983 dollars)*			941,005
Total (1984 dollars)*			1,035,105

* Calculated at an inflation rate of 10 percent per year.

Figure 3-7. Site 35, proposed closure implementation schedule.



approximately 18 feet below the ground surface, and flows east-northeast to the Arkansas River (see Appendix B). State regulations require that the lagoons be treated as hazardous waste disposal sites. Therefore, a closure/post-closure plan will be required.

3.5.8.1 Assumptions

The major assumptions inherent in this closure plan are:

- The lagoon liners have maintained their integrity, and will perform satisfactorily during the post-closure period.
- The sludge remaining in the pond is a hazardous material.

3.5.8.2 Closure Considerations

Closure of these ponds will involve the following actions:

1. Decant fluid remaining in the ponds at the time of closure, and treat as appropriate, based on its actual characteristics.
2. Inspect pond liners to determine their condition.
3. Allow sludge remaining in the ponds to dry, or mix with soil to allow it to be thoroughly compacted. Backfill the ponds with common borrow, and place and compact in thin lifts to the top of the dikes.
4. Cap the backfilled lagoon with 24 inches of impermeable cover, placed in 8-inch (compacted thickness) lifts. Place topsoil over the clay cover, final-grade to promote runoff, and revegetate.
5. Set monument(s) to delineate the location of the closed site.

The existing site contours are suitable to prevent run-on. The features of the closed site are shown on Sheet 10, and cost estimates for site closure are presented in Table 3-9. An implementation schedule for closure is presented in Figure 3-8.

3.5.8.3 Post-Closure Care

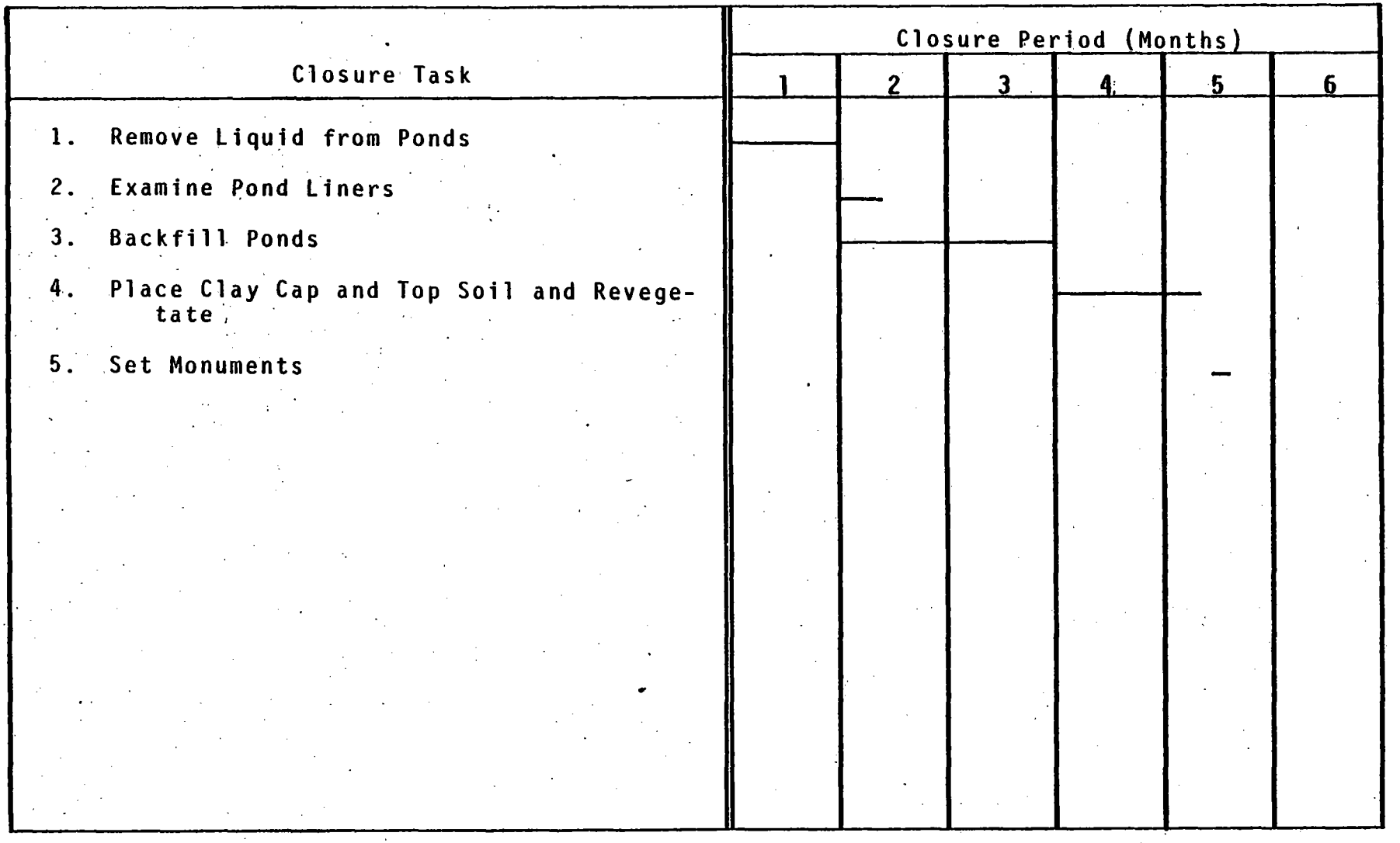
Since hazardous materials will remain subsequent to site closure, post-closure care and ground water monitoring will be required. Since little or no settlement of the cover is anticipated, post-closure care requirements should be minimal, and will consist of correction of erosion or other damage to the cover. A site inspection form is presented as Figure 4-1. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $2,000 (1984 dollars).

TABLE 3-9. SITE 36 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Ordinary Fill	22,700 m^3	3.00/m^3	68,100
Low-Permeability Fill	11,300 m^3	3.00/m^3	33,900
Topsoil	5,700 m^3	3.00/m^3	17,100
Revegetation	18,600 m^2	1.25/m^2	23,250
Subtotal			142,350
Engineering/Permit Fee (15% of Subtotal)			21,355
Contingencies (20% of Subtotal)			28,470
Total (1982 dollars)			192,175
Total (1983 dollars)*			211,395
Total (1984 dollars)*			232,530

* Calculated at an inflation rate of 10 percent per year.

Figure 3-8. Site 36, proposed closure implementation schedule.



A ground water monitoring system and plan have been implemented for this facility.

3.5.8.4 Additional Investigations

None.

3.5.9 Site 40, Incinerator Complex

The incinerator complex at PBA is a new facility designed to treat chemical and other wastes susceptible to thermal destruction. This facility is operated in conjunction with salvage operations. During operation of the facility, some spillage of waste material will likely occur during storage and transport. However, soil contamination should be minimal due to the design safeguards built into the facility. A generalized description of the site's geologic conditions is presented in Appendix B.

3.5.9.1 Assumptions

The major assumption inherent in this plan is that hazardous material will remain at the site subsequent to closure.

3.5.9.2 Closure Considerations

The first consideration in the closure of this facility will be to determine the extent, if any, of soil contamination. The analyses to be performed should consist of soil bore tests as well as testing of production structures and process equipment for contamination. All contaminated structures and process equipment should be freed of contamination, and disposed of at a sanitary landfill, be salvaged, or go to property disposal for retirement, as appropriate. If the structures and equipment cannot be properly decontaminated, they should be removed from the site and disposed of at a hazardous waste landfill. All uncontaminated structures and equipment should be salvaged or disposed of at a sanitary landfill.

If soil bore tests indicate that contamination is confined to a relatively small volume of soil, the contaminated soils should be excavated and placed in a hazardous waste landfill. If decontamination of the sites is successful, no further action will be necessary.

If testing indicates widespread contamination of the soils throughout the site, the following steps should be initiated:

1. Establish run-on diversion trenches to divert run-on.

2. Cover the site with 24 inches of compacted impervious silty clay material graded to promote runoff.

3. Place 12 inches of topsoil over the clay cover and disturbed areas, and revegetate the site.

4. Develop a ground water monitoring plan (it may be possible to utilize existing wells).

5. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The features of the closed site are shown on Sheet 11. Cost estimates for implementation of the closure plan are presented in Table 3-10 (this estimate assumes widespread contamination of the site). An implementation schedule for closure is presented in Figure 3-9.

3.5.9.3 Post-Closure Care

If the area is decontaminated, no post-closure care will be required. However, if hazardous materials remain at the site, post-closure care and ground water monitoring will be required. Since little or no settlement of the final cover is anticipated, maintenance should be minimal. The site should be inspected periodically during closure. An inspection form is presented in Table 4-1. Inspections should be made twice a year for 2 years, and annually thereafter. Maintenance would be scheduled in response to damage noted during site inspections, and should consist of repairing any damage to the cover caused by erosion. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $3,000 (1984 dollars).

3.5.9.4 Additional Investigations

None.

3.5.10 Site 42, Water Treatment Backwash Pond

The water treatment backwash pond is classified as a hazardous waste impoundment, because it receives industrial wastewaters. This concrete basin is 62 feet wide by 91 feet long (external dimensions), and 8 feet deep, with 1:1 side slopes. There is no evidence to suggest that significant soil contamination has resulted from use of this facility. Available data indicate that this facility is actually nonhazardous. A generalized description of the site geology is presented in Appendix B.

3.5.10.1 Assumptions

Development of the closure/post-closure plan requires that a number of assumptions be made, including:

- Wastewater and sludge remaining in the basin at the time of closure are assumed to be hazardous, and will require treatment and/or disposal.

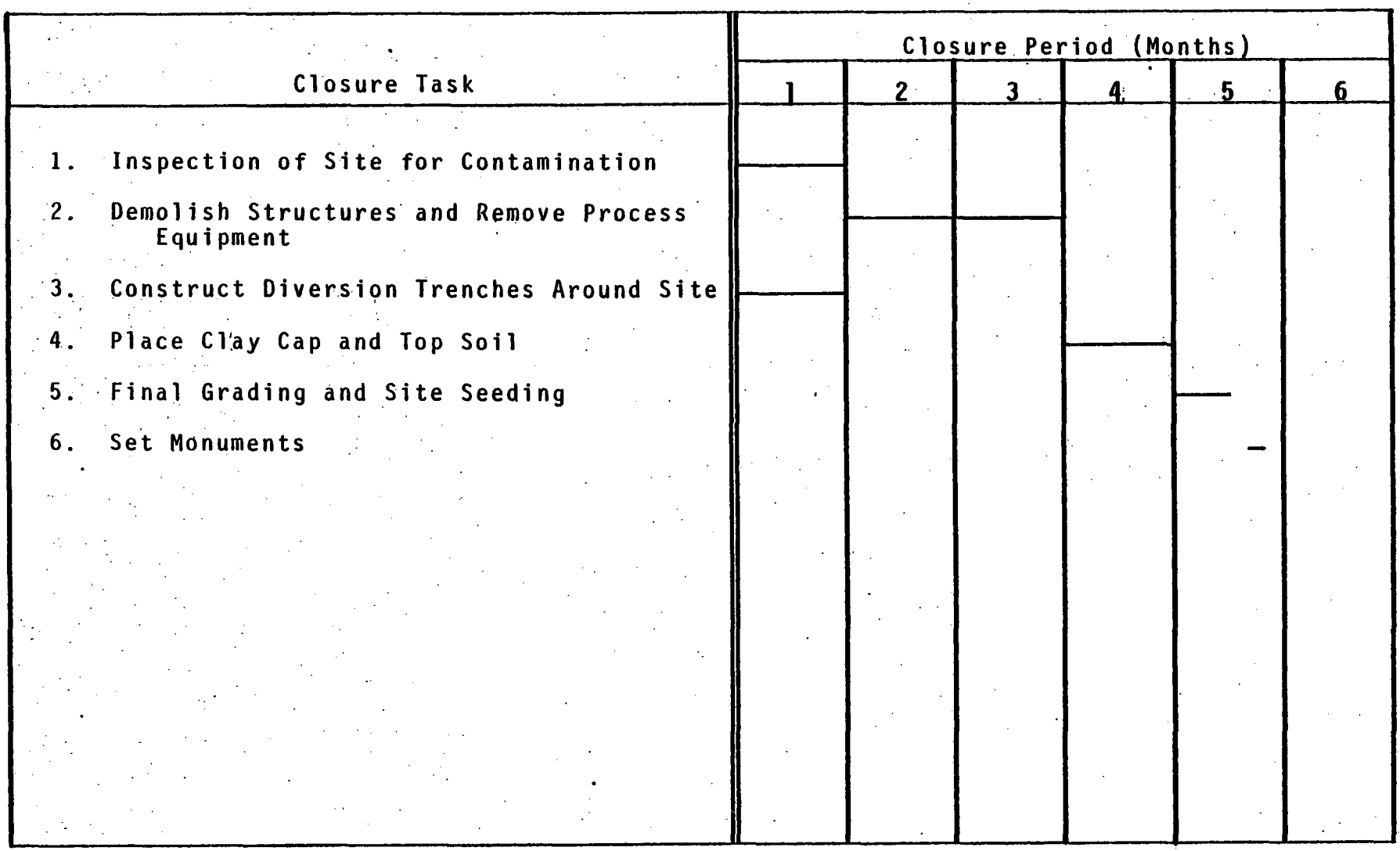
- There is no contaminated soil material resulting from this facility's use.

TABLE 3-10. SITE 40 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Low-Permeability Fill	6,800 m^3	3.75/m^3	25,500
Swale/Channel	1,500 m^3	4.38/m^3	6,570
Topsoil	3,400 m^3	3.75/m^3	12,750
Demolition, Concrete	4,000 m^3	8.84/m^3	35,360
Revegetation	11,150 m^2	1.56/m^2	17,395
Subtotal			97,575
Engineering/Permit Fee (15% of Subtotal)			14,635
Contingencies (20% of Subtotal)			19,515
Total (1982 dollars)			131,725
Total (1983 dollars)*			144,900
Total (1984 dollars)*			159,385

* Calculated at an inflation rate of 10 percent per year.

Figure 3-9. Site 40, proposed closure implementation schedule.



- Once the wastewater and sludge have been removed, the facility can be considered nonhazardous (i.e., no hazardous material will remain).

3.5.10.2 Closure Considerations

Closure of this facility will involve the following actions:

1. Remove any remaining fluid to the water treatment plant.

2. Remove remaining sludge/residue to the proposed secure landfill.

3. Flush the basin, effluent drain pipe, and stilling well with water. The disposition of this water will depend upon its characteristics. If the final rinse water exhibits significant contamination, the interior of the basin, effluent pipe, and still well will require flushing with solvent. It is suspected that this latter step will not be necessary. Once decontaminated, the existing drain can be used to permit precipitation to escape from the enclosed basin.

4. Fill the influent industrial sewer pipe with 3 feet of sand at both ends, and seal with cement plugs.

The decontamination of the existing drain structure may prove to be somewhat difficult. If this is the case, the existing 8-inch drain can be provided with a 4-inch PVC sleeve, and the annulus between the two pipes sealed with cement grout. Features of the closed site are shown on Sheet 12, and estimated closure costs are shown in Table 3-11. A closure schedule is presented in Figure 3-10.

3.5.10.3 Post-Closure Care

Since no hazardous material will remain at the site, no post-closure care or monitoring will be required. If decontamination of the cement drain pipe should prove difficult and complete decontamination is not achieved (i.e., the pipe is sleeved and the annulus sealed), the quantity of hazardous material potentially remaining at the site does not appear to warrant further consideration.

It is suggested that, subsequent to closure, the site be occasionally inspected to ensure that the impoundment is draining properly. Accumulation of rainwater in the basin could represent a safety hazard.

3.5.10.4 Additional Investigations

The actual characteristics of the wastewaters and sludge stored in the backwash pond are not known. Prior to final design of the closure plan, analysis of both the wastewater and residue

TABLE 3-11. SITE 42 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Sludge Removal/Disposal	160 m^3	62.50/m^3	10,000
Cleaning Concrete	2,000 m^2	40.12/m^2	80,240
Subtotal			90,240
Engineering/Permit Fee (15% of Subtotal)			13,535
Contingencies (20% of Subtotal)			18,050
Total (1982 dollars)			121,825
Total (1983 dollars)*			134,010
Total (1984 dollars)*			147,410

* Calculated at an inflation rate of 10 percent per year.

Figure 3-10. Site 42, proposed closure implementation schedule.

Closure Task	Closure Period (Months)					
	1	2	3	4	5	6
1. Remove Wastewater	—					
2. Residue/Sludge Removal	—					
3. Cleaning Basin and Stilling Well	—					
4. Plug Influent Pipe with Grout	—					

is recommended. Likewise, a sample of concrete from the basin should be obtained and analyzed in accordance with EP toxicity procedures to confirm its nonhazardous nature.

Unless the basin has a history of leakage, it is not likely that the soil has become contaminated at this site. We do, however, recommend that limited investigations be conducted to confirm this assessment. This investigation should include a detailed review of the impoundment's use and maintenance history, and analysis of several selected soil samples for potential contaminants.

3.5.11 Site 43, White Phosphorus Pollution Abatement Facility

Site 43 is the white phosphorus pollution abatement facility. Due to the anticipated buildup of contaminants at the site from spillage and process discharges, it is believed that hazardous waste materials will remain at the site after closure of the facility. A generalized geologic description of the site is presented in Appendix B.

3.5.11.1 Assumptions

The major assumption inherent in this plan is that hazardous materials will remain after closure.

3.5.11.2 Closure Considerations

The first consideration in closure of this facility will be to determine the extent, if any, of contamination. The analyses should consist of soil bore tests, as well as testing of production structures and process equipment for contamination. All contaminated structures and process equipment should be freed of contamination, and disposed of at a sanitary landfill, be salvaged, or go to property disposal for retirement. If the structures and equipment cannot be properly decontaminated, they should be removed from the site and disposed of at a hazardous waste landfill. All uncontaminated structures and equipment should be salvaged or disposed of at a sanitary landfill.

If testing indicates that contamination is confined to a relatively small volume of soil, the contaminated soil should be excavated and transported to a hazardous waste landfill. If decontamination of the site is successful, no further action will be necessary.

If testing indicates widespread contamination of the soil, the following steps will be required:

1. Establish run-on diversion trenches to divert run-on.

2. Cover each site with 24 inches of compacted impervious silty clay graded to promote runoff.

3. Place 12 inches of topsoil over the cover, and revegetate the site.

4. Develop a ground water monitoring plan for the site, possibly using existing ground water monitoring wells.

5. Set monument(s) and prepare a plot plan to delineate the closed site.

The features of the closed site are shown on Sheet 13. A cost estimate for implementation of the closure plan is presented in Table 3-12 (this estimate assumes widespread contamination of the site). An implementation schedule for closure is presented in Figure 3-11.

3.5.11.3 Post-Closure Care

If the area is decontaminated, no post-closure care will be required. However, if hazardous material remains at the site after closure, ground water monitoring and post-closure care will be required. Since little or no settlement of the final cover is anticipated, maintenance requirements should be minimal. The site should be inspected semiannually for 3 years, and annually thereafter. Maintenance would be scheduled in response to any damage noted during the inspections. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $3,000 (1984 dollars).

3.5.11.4 Additional Investigations

None.

3.5.12 Site 7b, Lewisite Disposal Area

The abandoned Lewisite disposal area consists of an unlined lagoon adjacent to a small creek, a tributary to Phillips Creek. Considerable volumes of white sludge remain in the old lagoon. Some of this material has been transported downstream, and is found on the banks and in the bed of the small creek. This sludge is a hazardous waste according to EP toxicity criteria, due to its high arsenic and selenium contents.

During site reconnaissance, springs and seeps were observed to the north of this site, indicating that a near-surface perched water table exists at least seasonally in the general area. A generalized geologic description of the area is presented in Appendix B.

3.5.12.1 Assumptions

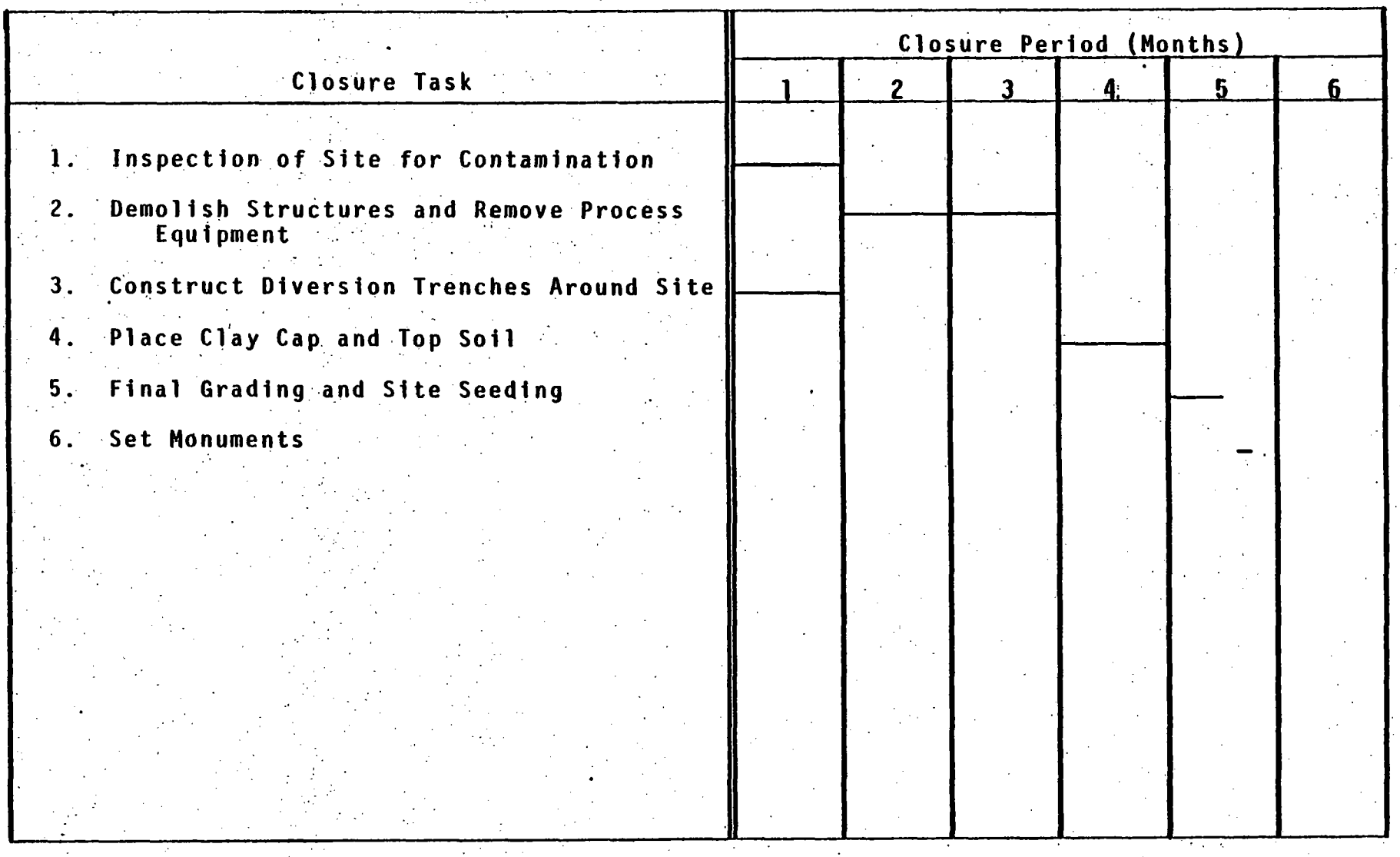
See Section 3.5.15.

TABLE 3-12. SITE 43 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Low-Permeability Fill	54,380 m^3	2,55/m^3	138,670
Swale/Channel	4,500 m	2.98/m	13,410
Topsoil	27,190 m^3	2.55/m^3	69,335
Demolition, Concrete	8,000 m^3	6.01/m^3	48,080
Revegetation	89,220 m^2	1.06/m^2	94,575
Subtotal			364,070
Engineering/Permit Fee (15% of Subtotal)			54,610
Contingencies (20% of Subtotal)			72,815
Total (1982 dollars)			491,475
Total (1983 dollars)*			540,645
Total (1984 dollars)*			594,710

* Calculated at an inflation rate of 10 percent per year.

Figure 3-11. Site 43, proposed closure implementation schedule.



3.5.12.2 Closure Considerations

In situ closure of the site is recommended despite the generally poor site conditions. The rationale for this decision is discussed in Section 3.5.15. Closure of the Lewisite disposal area will involve the following actions:

1. Channelize the small creek adjacent to the site. The channel should be lined in an effort to lower the perched ground water table in the vicinity of the site.

2. Dewater the lagoon, if necessary. Test the discharge and transport to the treatment facility, if required.

3. Excavate the sludge and contaminated soil (including that transported downstream by erosion), and stockpile at one end of the lagoon. Provide the excavated area with an impervious liner constructed of natural silty clay materials, and place the stockpiled sludge and contaminated soil on the lined area along with the sludge and contaminated soil from the unlined end of the lagoon. The remainder of the lagoon should be lined, and the liners made contiguous. The contaminated material should then be spread and compacted within the liner.

4. Place an impervious cover of silty clay material over the lined area. Grade the cover to promote drainage, and key into the liner to provide complete encapsulation of the hazardous waste.

5. Cover all disturbed areas with topsoil and revegetate.

6. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The features of the closed site are shown on Sheet 14, and cost estimates for implementation are shown in Table 3-13. A proposed implementation schedule is presented in Figure 3-12.

3.5.12.3 Post-Closure Care

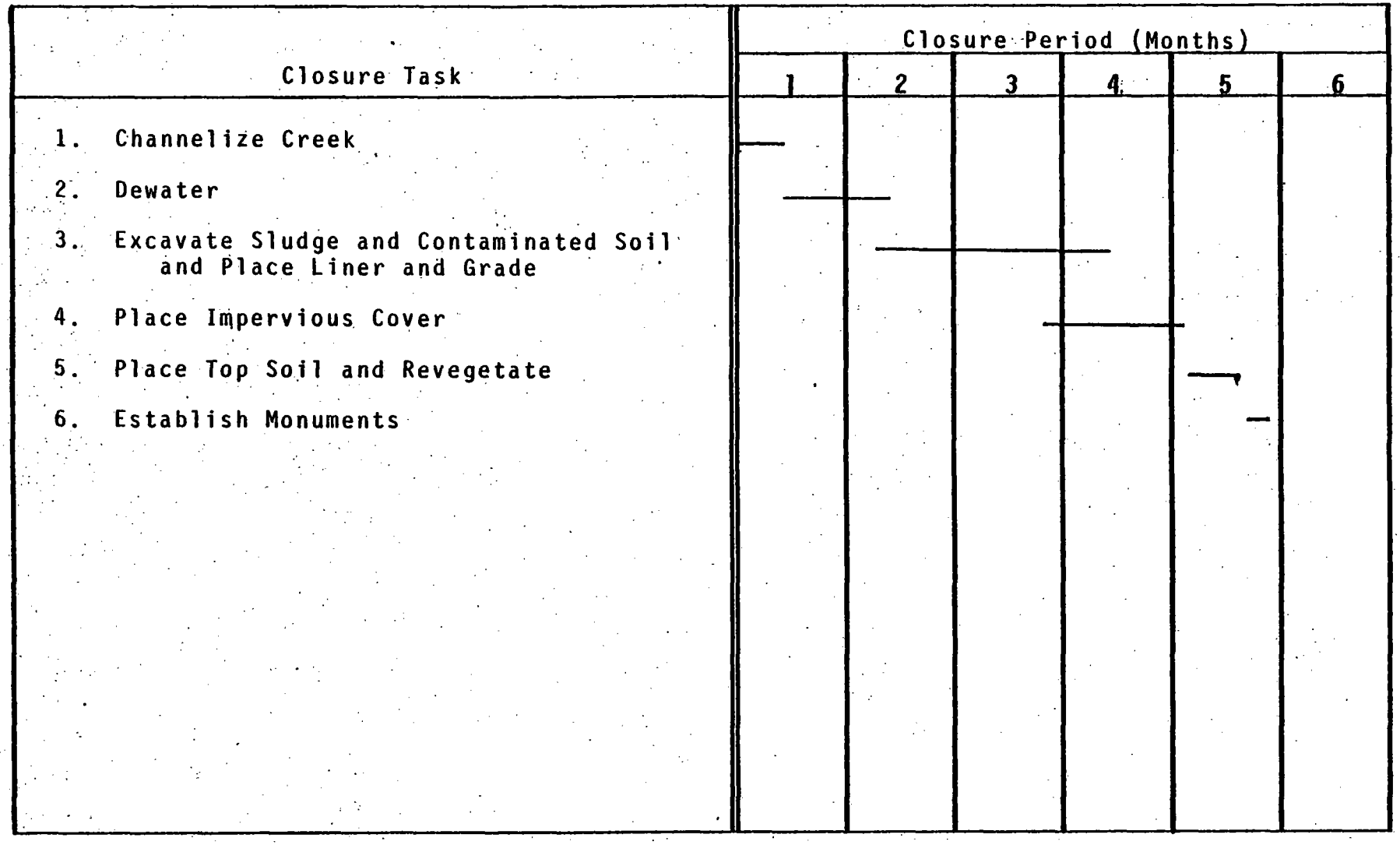
Since hazardous materials will remain after closure, post-closure care and monitoring will be required. A ground water monitoring system and plan is operational for this facility. The site should be inspected quarterly for the first 3 years after closure, and annually thereafter, provided inspection results do not indicate the need for more frequent inspections. A site inspection form is presented as Table 4-1. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $5,000 (1984 dollars).

TABLE 3-13. SITE 7B COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	32,390 m^2	0.23/m^2	7,450
Earth Movement/Grading of Contaminated Material	80,150 m^3	2.77/m^3	222,015
Ordinary Fill	5,530 m^3	2.55/m^3	14,100
Low-Permeability Fill	46,560 m^3	2.55/m^3	118,730
Berms/Levees	15 m^3	4.25/m^3	60
Swale/Channel	410 m	2.98/m	1,220
Revegetation	58,700 m^2	1.06/m^2	62,220
Topsoil	17,940 m^3	2.55/m^3	45,750
Subtotal			471,545
Engineering/Permit Fee (15% of Subtotal)			70,730
Contingencies (20% of Subtotal)			94,310
Total (1982 dollars)			636,585
Total (1983 dollars)*			700,245
Total (1984 dollars)*			770,270

* Calculated at an inflation rate of 10 percent per year.

Figure 3-12. Site 7b, proposed closure implementation schedule.



Since only minor settlement of the final cover is anticipated, post-closure care is expected to be minimal. It should consist of repairs to the cover to correct erosion or other damage, as required. Considering the completely encapsulated nature of the site, we recommend that a piezometer be placed within the waste. If the piezometer indicates that leachate accumulates within the site, the need for a leachate collection sump should be evaluated.

3.5.12.4 Additional Investigations

See Section 3.5.15.

3.5.13 Site 7c, Mustard Agent Burning Yard

The mustard agent burning yard is located south of the old TSY (Site 7a) and east of Sites 7b and 7d, on the banks of a small intermittent creek, a tributary of Phillips Creek. The site is covered by a layer of ash and mustard agent residue. Fragments of this material were noted in the creek bed which is encroaching upon the site. Previous investigators have reported that this material is visibly volatile, and emits irritating fumes. Irritating emissions were noted during site reconnaissance.

Previous investigations at this site have identified that soil beneath the mustard agent residue was contaminated with heavy metals. Anomalous but relatively low concentrations of arsenic, chromium, mercury, and zinc were found. The site is apparently underlain, at depth, by the fine-grained sediments of the Jackson Group (see Appendix B). The mustard agent burning yard has been classified as a potential health hazard by the State of Arkansas.

3.5.13.1 Assumptions

See Section 3.5.15.

3.5.13.2 Closure Considerations

Closure of the mustard agent burning yard will involve the following actions:

1. Excavate the mustard agent residue, and transport to either the PBA incinerator complex for destruction or the secure landfill.

2. Excavate and stockpile the contaminated soil to permit installation of a compacted silty clay liner in the excavation. Place the contaminated soil in the liner and compact in thin lifts.

3. Cap the site with an impervious silty clay cover, grade to promote runoff, and key the cover into the liner.

4. Channelize the small intermittent creek to prevent future erosion of the closed site.

5. Spread topsoil over the disturbed areas and revegetate the site.

6. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The features of the closed plan are shown on Sheet 14, and estimated closure costs are shown in Table 3-14. An implementation schedule is presented in Figure 3-13.

3.5.13.3 Post-Closure Care

Since hazardous material will remain at the site after closure, post-closure care and monitoring will be required. A ground water monitoring system has recently been installed and a monitoring plan implemented for Site 7c.

Post-closure care will likely be minimal, and will consist of repair of erosion or other damage to the final cover, as required, based on site inspections. An inspection form is presented in Table 4-1. Inspections should be made quarterly for 3 years, and annually thereafter. The estimated annual post-closure care (maintenance) coss for this site, exclusive of monitoring and inspection efforts, is approximately $2,000 (1984 dollars). As with Site 7b, a piezometer should be installed in the encapsulated waste material to permit assessment of leachate development, should it occur.

3.5.13.4 Additional Investigations

See Section 3.5.15.

3.5.14 Site 7d, Toxic Storage Yard Borrow Pits

Site 7d consists of two old borrow pits approximately 400 feet long by 50 feet wide which are filled with water. This site is located immediately south of the old TSY (Site 7a). Laboratory refuse and associated waste materials are found in and adjacent to these trenches. In the past, they have been used as catchment for hazardous materials spilled at the old TSY. The site is presently considered a health hazard, and requires a closure/post-closure plan. A general description of the site geology is presented in Appendix B.

3.5.14.1 Assumptions

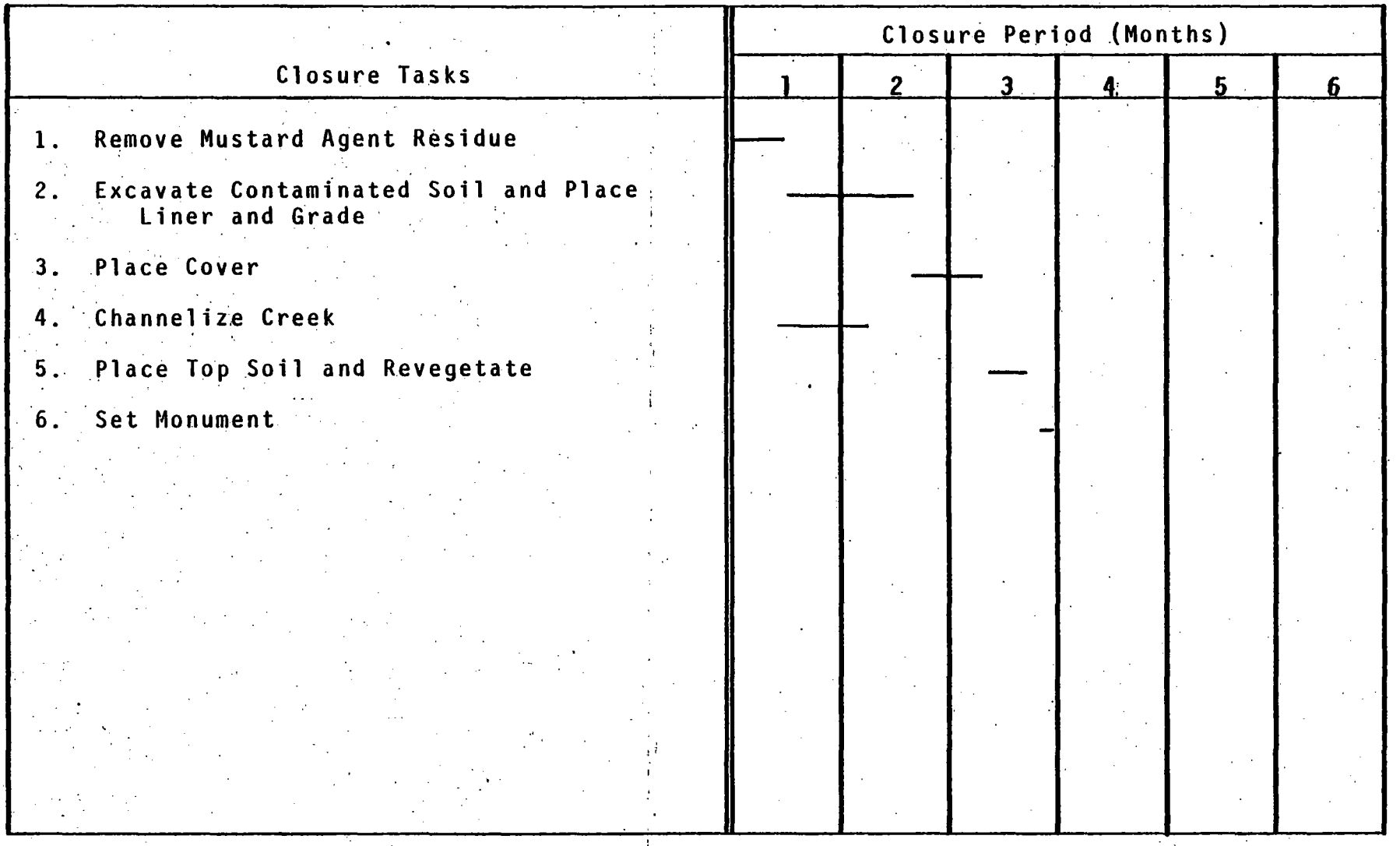
See Section 3.5.15.

TABLE 3-14. SITE 7C COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	8,100 m^2	0.23/m^2	1,860
Excavation of Contaminated Material	9,140 m^3	2.77/m^3	25,320
Earth Movement/Grading of Contaminated Material	12,370 m^3	2.77/m^3	34,260
Low-Permeability Fill	7,310 m^3	2.55/m^3	18,640
Revegetation	2,460 m^2	1.06/m^2	2,610
Topsoil	8,910 m^3	2.55/m^3	22,720
Subtotal			105,410
Engineering/Permit Fee (15% of Subtotal)			15,810
Contingencies (20% of Subtotal)			21,080
Total (1982 dollars)			142,300
Total (1983 dollars)*			156,530
Total (1984 dollars)*			172,185

* Calculated at an inflation rate of 10 percent per year.

Figure 3-13. Site 7c, proposed closure implementation schedule



3.5.14.2 Closure Considerations

Closure of Site 7d will involve the following actions:

1. Channelize the creek.

2. Dewater the pits. Discharge the water into the channelized streams, or transport to PBA's treatment facility, depending on its characteristics.

3. Excavate the waste material, sludge, and contaminated soils, and stockpile at one end of the site. Considering the proximity of the pits to one another, they should be treated as a single area for this operation. Line the excavated area with natural silty clay material. The stockpiled materials and waste/contaminated materials found at the other end of the site will then be moved onto the lined area, and the resultant excavation will also be provided with a liner. The hazardous materials, now contained within the liner, will be spread and compacted.

4. Place an impervious cover comprised of silty clay material over the site. Compact the cover, and key into the liner to provide for complete encapsulation of the hazardous materials.

5. Spread topsoil over the site and revegetate the area.

6. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The features of the closure plan are shown on Sheet 14, and estimated closure costs are presented in Table 3-15. A proposed implementation schedule is presented in Figure 3-14.

3.5.14.3 Post-Closure Care

Since hazardous materials will remain after closure, post-closure care and ground water monitoring will be required for Site 7d. A ground water monitoring system has been installed and a monitoring plan implemented for this site.

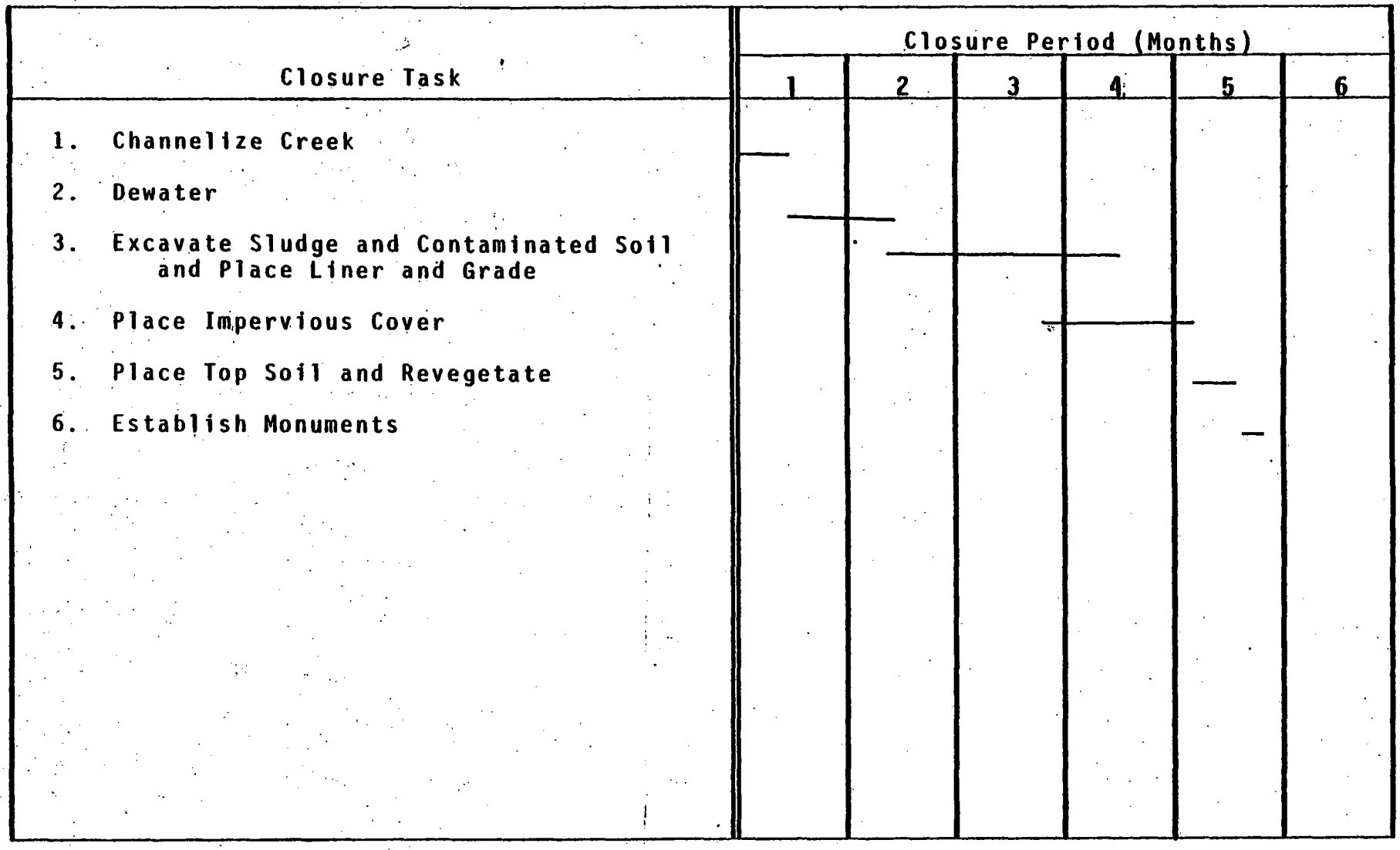
The site should be inspected quarterly for the first 3 years after closure, and annually thereafter, provided revegetation is satisfactorily accomplished. An inspection form is presented in Table 4-1. Since little, if any, settlement is anticipated, post-closure care should be minimal, and will consist of repairing erosion or other damage to the cover detected during inspections. The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $4,000 (1984 dollars).

TABLE 3-15. SITE 7D COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	12,140 m^2	0.23/m^2	2,790
Earth Movement/Grading of Contaminated Material	27,860 m^3	2.77/m^3	77,170
Ordinary Fill	2,950 m^3	2.55/m^3	7,525
Low-Permeability Fill	19,620 m^3	2.55/m^3	50,030
Swale/Channel	80 m	2.98/m	240
Draining Pond	4,170 m^3	2.85/m^3	11,880
Revegetation	22,270 m^2	1.06/m^2	23,600
Topsoil	6,690 m^3	2.55/m^3	17,060
Subtotal			190,295
Engineering/Permit Fee (15% of Subtotal)			28,545
Contingencies (20% of Subtotal)			38,060
Total (1982 dollars)			256,900
Total (1983 dollars)*			282,590
Total (1984 dollars)*			310,850

* Calculated at an inflation rate of 10 percent per year.

Figure 3-14. Site 7d, proposed closure implementation schedule.



Considering the encapsulated nature of the site, it is recommended that a piezometer be installed the waste material to allow any buildup of leachate to be monitored. If excessive leachate were to build up, it could be pumped out and transported to the treatment plant for disposal.

3.5.14.4 Additional Investigations

See Section 3.5.15.

3.5.15 Sites 7b, 7c, and 7d

The closure plans presented for these three sites are basically similar. In general, the natural conditions at these sites do not appear particularly favorable for in situ closure. The following considerations are important in assessing actions to be taken to clean up and close this group of sites:

1. Although the water in the drainage ways, which traverse Site 7d and lie adjacent to 7b, does not exhibit gross contamination, sediments accumulating within these drainage ways exhibit considerable contamination. This suggests that the contaminants are relatively insoluble. Considering the nature of the contaminants (primarily heavy metals) and the reportedly high pH of the surface waters in question, contaminant solubility should be low.

2. The run-on/runoff control plan recommended for Site 7a should exert considerable influence in lowering the perched water table in this area.

3. These three sites are interior to an environmental containment project currently under design for Area 5. This project will involve the routing of surface drainage from this and other areas into a series of lined retention/settlement basins designed to trap contaminants transported as sediment.

4. The recommendation to channelize the drainages and line the channels in the vicinity of these sites should improve site characteristics with regard to in situ closure and eliminate future erosion of the waste material.

5. There is no suitable repository for the apparently large volumes of waste found at these sites.

In view of the foregoing, it is recommended that the waste and contaminated soil be encapsulated in situ in clayey soils which possess a high potential for adsorption of the heavy metal contaminants.

It is also recommended that closure of these three sites be undertaken simultaneously, since:

- They are located close to one another along small tributaries to Phillips Creek.
- Contamination plumes resulting from these sites probably intermingle.
- A single cleanup/closure effort will be considerably more efficient and less expensive than three distinct projects.

Further, it is recommended that closure of these sites be undertaken subsequent to implementation of the Area 5 drainage containment project and the run-on/runoff control plan for Site 7a.

3.5.15.1 Assumptions

The major assumptions used in developing these closure plans are as follows:

- The low solubility of the heavy metal contaminants.
- The expected beneficial effects of the run-on/runoff control plan recommended for Site 7a and Area 5 containment project.
- The beneficial effects of channelizing and lining the drainage ways near the site.
- The need to construct impermeable liners beneath the sites to achieve encapsulation.

3.5.15.2 Additional Investigations

Prior to final design of these closure plans, detailed site subsurface and waste characterization investigations are required. These investigations need to address a number of issues, including:

- Extent and severity of contamination.
- Contaminant migration pathways/potential pathways.
- Changes in the ground water table depth and flow patterns that may be caused by modification of adjacent areas.
- The need to construct liners (one or more of the sites may be underlain by clay layers suitable to prevent vertical contaminant migration).
- Disposition of surface water that must be removed from the pits prior to construction.

- Possibility of combining sites into a single encapsulated area.

Upon completion of these investigations, the closure plans submitted herein should be reviewed and modified, as appropriate.

3.5.16 Site 10, West Bombing Mat and Waste Storage Yard

The west bombing mat, formerly used for product testing, is currently used as a hazardous waste storage yard. Barrels of chemical materials are stored on the extensive concrete apron in this area. To the west of the mat is a disposal area and a burning ground. Considerable volumes of wood crates, demolished buildings, spent casings, disarmed grenades, chemical rocket propellors, and drums of chemicals are stored here.

Several trenches have been excavated across the disposal area/burning ground, and the southernmost appear to penetrate below the ground water table (i.e., ponded water and vegetation indicative of swampy conditions were observed). These trenches are partially filled with debris and/or ashes. The west edge of the site drops off abruptly to a boggy area, the floodplain of Phillips creek, a tributary to the Arkansas River. A generalized description of the site's geology is presented in Appendix B.

During previous investigations, anomalous concentrations of lead and mercury were encountered in soil samples taken at this site.

The bombing mat requires a run-on/runoff control plan. The entire area of Site 10 requires a closure/post-closure plan. The bombing mat and disposal area are treated separately herein.

3.5.16.1 Bombing Mat

3.5.16.1a Assumptions

The major assumption inherent in this closure plan is that there are currently no serious soil contamination problems. Implementation of the run-on/runoff control program will thus preclude future occurrences. Once the pavement is decontaminated, there will be no hazardous waste remaining at the site.

3.5.16.1b Run-on/Runoff Control Plan

A run-on/runoff control plan has been developed for the bombing mat, and is presented on Sheet 3. The major structures required to control surface water at this site include:

- Lined peripheral ditches and berms to divert run-on and collect runoff. (These ditches are lined to prevent infiltration of contaminated runoff, and hence to reduce the potential for ground water contamination.)

- A lined retention basin to hold runoff prior to discharge or transport to the pollution abatement facility.

- Sealed pavement joints to prevent infiltration of precipitation.

Estimated costs for implementation of the run-on/runoff control plan are presented in Table 3-16.

3.5.16.1c Closure Considerations

Subsequent to implementation of the run-on/runoff control plan for the bombing mat, closure of the site will involve only minor additional efforts. The mat is used as a hazardous waste storage yard to provide storage for stockpiled waste materials prior to their incineration. Thus, at the time of closure, these waste materials will have been removed to the PBA incinerator complex for destruction. Closure will require decontamination of the pavement in areas where hazardous waste has been stored. Provided that the decontamination efforts are successful, the closed site should require no further action.

3.5.16.1d Post-Closure Care

The need for post-closure care at the bombing mat will be predicated on the presence of contaminated soil beneath or adjacent to the pavement. The information presently available suggests that this is not a concern. A ground water monitoring system has been installed and a monitoring plan implemented for this site. If the monitoring results over the next few years are positive, post-closure care, including regular ground water monitoring, will not be required.

If the ground water monitoring results suggest that subpavement contamination exists, the proposed features of the run-on/runoff control system will be used as final cover in protecting the closed disposal site. In this case, ground water monitoring and maintenance of these features would be required. The required maintenance effort would likely be minimal, consisting of periodic site inspections and repairs to the pavement and run-on/runoff control structures, as needed. Based on the available data, post-closure care is considered to be unnecessary.

3.5.16.1e Additional Investigations

It will be necessary to determine whether or not post-closure care is needed. The existing ground water monitoring system should provide this information. The ground water flow conditions and quality beneath the site should be carefully reviewed. If required, a suitable supplementary ground water monitoring program can then be developed to determine both short- and long-term effects of implementation of the run-on/ runoff control system.

TABLE 3-16. SITE 10 COST ESTIMATE FOR IMPLEMENTATION OF PROPOSED RUN-ON/RUNOFF CONTROL SYSTEM

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation	10,420 m^3	2.50/m^3	26,050
Dumped Riprap	500 m^3	25.50/m^3	12,750
Backfill - common	3,550 m^3	3.00/m^3	10,650
Earth Movement/Grading	3,550 m^3	2.50/m^3	8,875
Clearing and Grubbing	3.5 acres	1,100/acre	3,850
Berms/Levees	10,390 m^3	5.00/m^3	51,950
Swale/Channel	2,115 m	3.50/m	7,405
Sand	4,070 m^3	8.50/m^3	34,595
Clay Liner from On-Site	13,940 m^3	5.00/m^3	69,700
Low-Permeability Fill	3,700 m^3	3.00/m^3	11,100
Fencing	650 m	40.00/m	26,000
Culvert Pipe - 18" dia	25 m	29.60/m	740
Class V Reinforced Concrete Pipe - 18" dia	50 m	47.70/m	2,385
Gate Valve - 18" dia	1	5,290 each	5,290
Leachate Sump and Piping	1	750 each	750
Bituminous Asphalt - 2" thick min	8,640	4.80/m^2	41,470
Revegetation	5,575 m^2	1.25/m^2	6,970
Topsoil	850 m^3	3.00/m^3	2,550
Subtotal			323,080
Engineering/Permit Fee (15% of Subtotal)			48,462
Contingencies (20% of Subtotal)			64,616
Total (1982 dollars)			436,158
Total (1983 dollars)*			479,775
Total (1984 dollars)*			527,750

* Calculated at 10 percent per year inflation.

If contamination resulting from past activities at the bombing mat is detected, and if ground water quality improves as a result of run-on/runoff control, then post-closure care will be warranted. If contamination is detected and water quality does not improve subsequent to run-on/runoff control implementation, then corrective action should be considered.

3.5.16.2 Disposal Area and Burning Ground

3.5.16.2a Assumptions

The major assumption inherent in this closure plan is that the site's subsurface conditions are suitable for in situ closure.

3.5.16.2b Closure Considerations

This facility needs to be closed in accordance with standards applicable to landfills. The available geologic data developed during monitoring well installation, and observations made during site reconnaissance suggest that in situ closure as recommended below is appropriate (see Appendix B).

Closure of this site will involve the following actions:

1. Remove nonhazardous debris (wood crates, demolished buildings, etc.) for disposal in the sanitary landfill or salvage.

2. Remove wastes presently stored in drums for appropriate treatment and/or disposal. Transport these materials to the hazardous waste storage yard immediately east of the site or to another repository as soon as possible. (At the time of site reconnaissance, some drums were noted to be overflowing, and others were badly rusted.)

3. Construct a temporary sedimentation basin.

4. Relocate all remaining ashes and waste material to the higher portions of the site above the seasonal high (perched) ground water elevation, and at least 2 feet above the design flood elevation (100-year flood elevation = 226 feet MSL datum).

5. Backfill the cleaned-out burning and disposal trenches with compacted, low-permeability native silty clay to an elevation of at least 228 feet.

6. Channelize Phillips Creek to prevent continued erosion into the disposal area.

7. Excavate contaminated soil zones peripheral to the site, and relocate this material to the higher portions of the site. Compact this material to a density of at least

100 lb per ft^3, and backfill the excavations with native soils. The actual compaction requirement will be established on the basis of borrow investigations and testing.

8. Grade the disposal area, and place fill and an impervious cover to reduce infiltration and to promote runoff.

9. Develop a peripheral ditch system to prevent run-on and to expedite runoff. Line the final cover of the ditches and swales to maintain its integrity.

10. Place topsoil and revegetate all disturbed areas.

11. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The features of the closed burning ground/disposal site are shown on Sheet 15. The estimated costs for implementation of the closure plan, excluding Steps 1 and 2 above, are presented in Table 3-17. An implementation schedule is presented in Figure 3-15. Steps 1 and 2 of the closure scenario are not shown on the schedule, since their timing is independent of the remainder of the closure scenario.

3.5.16.2c Post-Closure Care

This site will require post-closure care and maintenance in accordance with the standards applicable to hazardous waste landfills (i.e., ground water monitoring and maintenance of the cover, and run-on/runoff control features, as warranted). A ground water monitoring system and a monitoring plan are operational at this site. Since little or no settlement of the final cover is anticipated, quarterly inspections for 2 years and inspection each year thereafter appear adequate. Maintenance would be scheduled in response to damage noted during the inspections.

The estimated annual post-closure care (maintenance) cost for this site, exclusive of monitoring and inspection efforts, is approximately $11,000 (1984 dollars). This estimate includes care of both the bombing mat and disposal area. A post-closure site inspection form has been prepared, and is presented in Table 4-1.

3.5.16.2d Additional Investigations

Field investigations should be completed to confirm that:

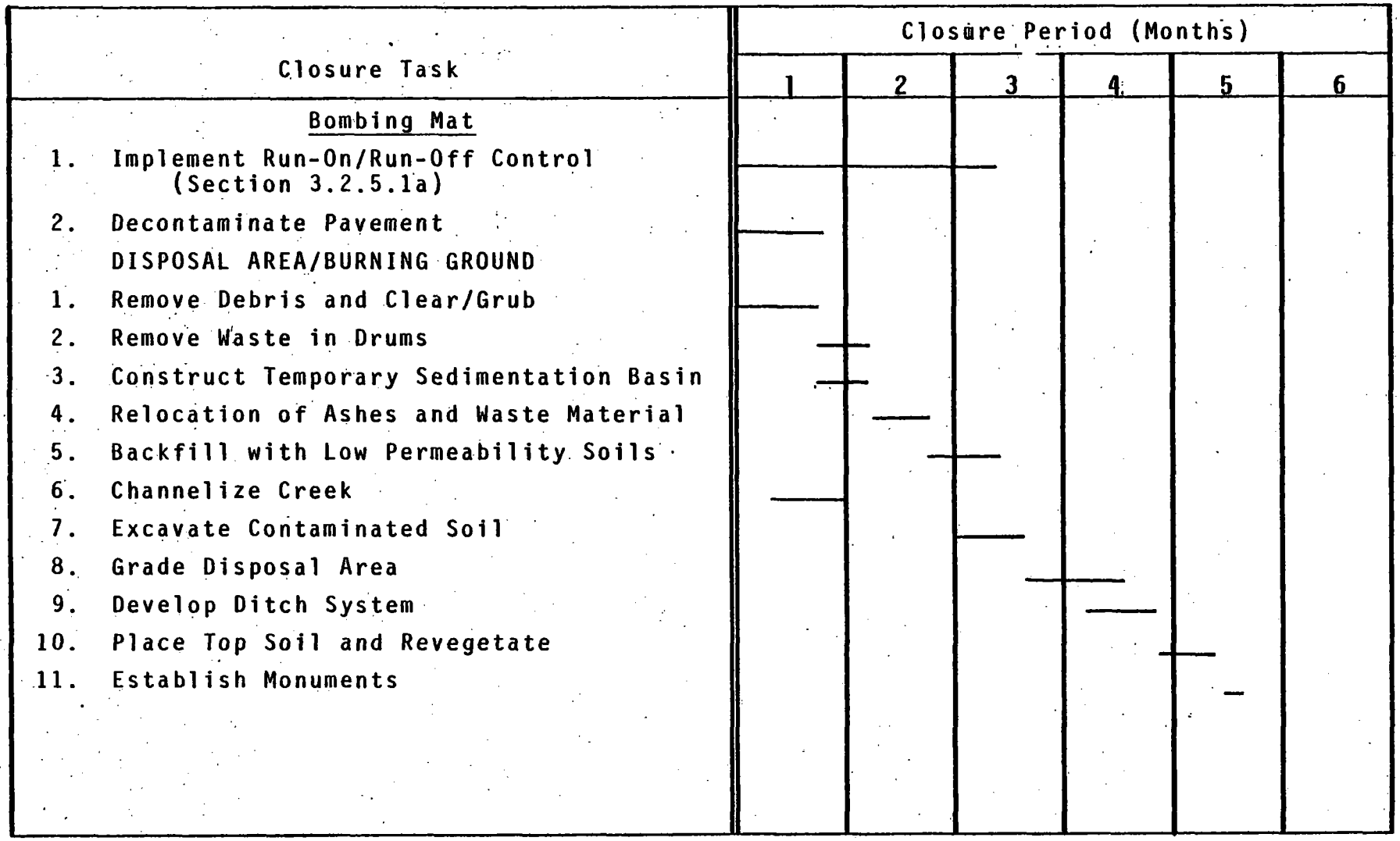
- Site conditions are suitable for in situ closure (particularly that the recommended actions provide for removal of contaminants above the perched seasonal water table).

TABLE 3-17. SITE 10 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	97,160 m^2	0.23/m^2	22,350
Excavation of Contaminated Material	78,370 m^3	2.77/m^3	217,080
Earth Movement/Grading of Contaminated Material	57,250 m^3	2.77/m^3	158,580
Ordinary Fill	81,720 m^3	2.55/m^3	208,385
Low-Permeability Fill	38,350 m^3	2.55/m^3	97,795
Swale/Channel	1,040 m	2.98/m	3,100
Excavation for Diversion Channel	6,170 m^3	2.13/m^3	13,140
Riprap	1,150 m^3	31.88/m^3	3,670
Revegetation	97,160 m^2	1.06/m^2	102,990
Topsoil	29,560 m^3	2.55/m^3	75,380
Subtotal			902,470
Engineering/Permit Fee (15% of Subtotal)			135,370
Contingencies (20% of Subtotal)			180,495
Total (1982 dollars)			1,218,335
Total (1983 dollars)*			1,340,170
Total (1984 dollars)*			1,474,185

* Calculated at an inflation rate of 10 percent per year.

Figure 3-15. Site 10, proposed closure implementation schedule.



- The contaminated soil, to be relocated at higher elevations, has been fully excavated and relocated.

The investigation of site conditions should be completed prior to final closure plan design. It should include several test borings and test pits, associated soil laboratory investigations, and chemical analyses. Its purpose will be to provide (1) a better definition of site conditions, (2) geotechnical design parameters, and (3) a more accurate delineation of the depth and extent of the excavations required for relocation of contaminated soil. The investigation of contaminated soil will consist of taking a number of grab samples from the bottoms and sides of the excavations made during implementation of the closure plan.

3.5.17 Site 17, Product Assurance Test Range and Dump Site

The product assurance test range and dump site was previously used for testing smoke grenades and disposal of refuse, such as expended grenades and pyrotechnical devices. The testing range is a shallow, impervious basin draining into a sump. Precipitation falling on the test range enters the sump, and is then transported to the PBA pollution abatement facility. The test range requires no action within the scope of this study.

The dump site is located along the shore of Yellow Lake. An erosional escarpment plunges from the general elevation of the test range and surrounding area (242 feet) to the level of the pond at an elevation of 202 feet (see Area A, Sheet 18). Two zones of contaminated soil (as evidenced by anomalous concentrations of arsenic, lead, mercury, and DDT) were detected by previous investigations (see Areas B and C, Sheet 16).

The escarpment is steep (near vertical locally), with evidence of recent erosion and sloughing. Considerable volumes of debris have been dumped over this escarpment and into the small ravines which dissect it. In some areas, the natural vegetation has been completely destroyed and buried by debris; at other locations, there is evidence of relatively severe distress. Locally, debris extends nearly to the lake margin at the toe of the slope. The characteristics of the debris emplaced at this site are unknown. However, analysis of grab samples indicates that it contains heavy metal concentrations in excess of EP toxicity criteria.

The extent of possible contamination of soil, ground water, and surface water resulting from dumping over this escarpment has not been adequately defined. However, it is possible that the major impacts of this uncontrolled dumping are limited to shallow soil contamination and surficial leachate entering the lake. Whether or not this actually occurs is dependent upon the site's hydrogeologic conditions. If ground water is discharging into the lake from the escarpment and lake margin, there is no reason to expect substantial subterranean contamination. It is pertinent to note that sections of the slope not directly impacted by

the placement of debris show evidence of instability and excessive erosion; this is possibly the result of ground water discharge through the face of the slope. The presence of the small pond several hundred feet to the south increases the potential for this condition by providing a source of local recharge for the stratified, sandy, and clayey soils that underlie the site. A generalized description of the geologic conditions at Site 17 is given in Appendix B.

In situ closure of the dump does not appear to be reasonable, since it is located on a slope that is at best marginally stable immediately adjacent to a lake. In situ closure would be difficult to implement, as it would likely require excessive post-closure care. It is thus recommended that the waste materials be relocated to a secure landfill. On the other hand, the two zones of contaminated soil can be provided with impervious cover, graded to promote rapid runoff and to prevent run-on, and closed in situ.

3.5.17.1 Assumptions

The closure plan presented herein is based on the following assumptions:

- Waste material deposited at the site is hazardous in nature.
- The area's hydrogeologic conditions are basically as described herein.
- Accelerated erosion of the refuse-covered bank is the result of both excess pore pressure and disturbance due to the placement of refuse.
- The contaminated soil zones (Areas B and C) are hazardous, as defined by RCRA.

3.5.17.2 Closure Considerations

The recommended closure scenario for Site 17 will involve the following actions:

1. Construct a sediment retention structure along the toe of the slope at the lake margin.
2. Permanently divert surface waters away from the sections of slope that are covered with debris.
3. Excavate the debris and contaminated soil (from Area A) and transport to a suitable repository. Simultaneously, remove any surficial debris found in Areas B and C.

4. Stabilize the disturbed slope and adjacent areas by means of backfilling to a uniform grade, compaction, and revegetation of the disturbed areas. Landscape netting may be used during slope revegetation to further facilitate stabilization.

5. Grub the areas of contaminated soil (Areas B and C), burn any organic material (wood, roots, etc.) on site, and spread and compact the ashes across the grubbed area.

6. Place an impervious cover over the contaminated areas and compact. The cover will extend a minimum of 5 feet beyond the periphery of the contaminated soil zones and be graded to promote runoff and prevent run-on. Place topsoil over the cover and revegetate the site.

7. Set monument(s) and prepare plot plans to delineate the closed areas.

The primary features of this closure plan are shown on Sheet 16. Cost estimates for its implementation are presented in Table 3-18, and a proposed implementation schedule is shown in Figure 3-16.

3.5.17.3 Post-Closure Care

Upon completion of the recommended closure plan, no hazardous waste will remain at Area A. As such, extensive post-closure care will not be required. Once the waste material and contaminated soil have been removed and the affected slopes rehabilitated, it will be necessary to monitor the modified and revegetated areas until their stabilization is satisfactory. Inspections should be conducted annually for the first 3 years, and every 2 years thereafter until vegetation is reestablished. Inspections may be discontinued once vegetation has become well established and the site stabilized. Maintenance will need to be scheduled in response to conditions observed during the inspections. A site inspection form is presented in Table 4-1.

Maintenance of Areas B and C will be minimal. However, since hazardous materials will remain after closure, ground water monitoring and post-closure care will be required. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $500 (1984 dollars).

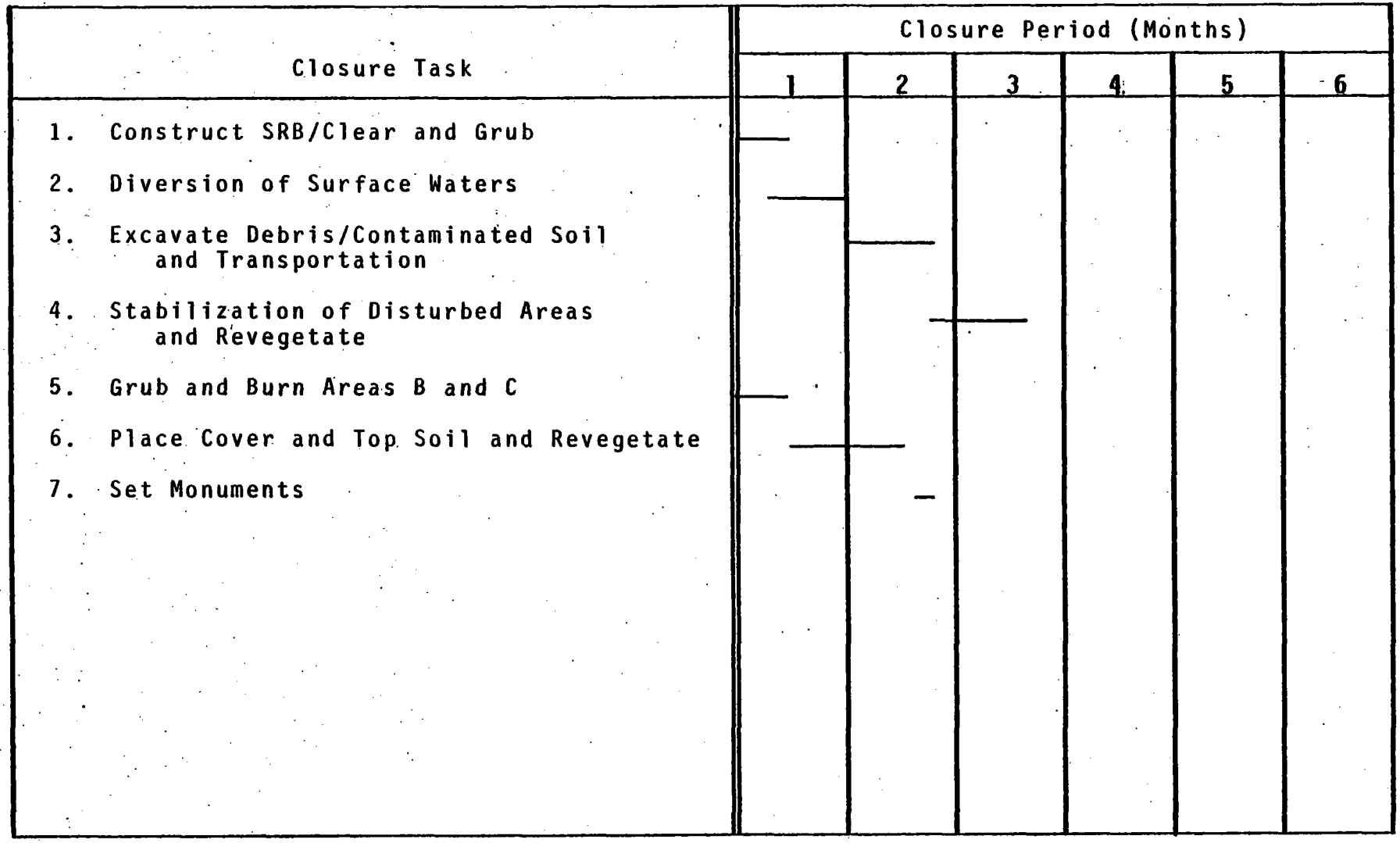
A ground water monitoring system and a monitoring plan have been implemented at this site.

TABLE 3-18. SITE 17 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	10,120 m^2	0.23/m^2	2,330
Excavation of Contaminated Material	65,820 m^3	2.77/m^3	182,320
Ordinary Fill	32,060 m^3	2.55/m^3	81,755
Low-Permeability Fill	5,000 m^3	2.55/m^3	12,750
Berms/Levees	1,010 m^3	4.25/m^3	1,260
Swale/Channel	4,070 m	2.98/m	12,130
Pavement Sealing		0.66/m^2	
Revegetation	20,240 m^2	1.06/m^2	21,450
Topsoil	6,920 m^3	2.55/m^3	17,650
Subtotal			331,645
Engineering Permit Fee (15% of Subtotal)			49,745
Contingencies (20% of Subtotal)			66,330
Total (1982 dollars)			447,720
Total (1983 dollars)*			492,490
Total (1984 dollars)*			541,740

* Calculated at an inflation rate of 10 percent per year.

Figure 3-16. Site 17, proposed closure implementation schedule.



3.5.17.4 Additional Investigations

Prior to final design of the closure plan, it will be necessary to conduct additional investigations at this site. The purposes of these investigations are to:

- Define the actual quantities of waste material and its characteristics, as well as any contaminated soil zones that will need to be removed during closure.
- Delineate the site's hydrogeologic and subsurface conditions to confirm the suitability of the proposed closure plan and to permit evaluation of slope stability considerations.

3.5.18 Site 20a, Depot South Burning Pit

Site 20a consists of the 5-acre depot south burning pit and the adjacent hazardous waste storage area. In the past, the area was used as an old burning area and dump site for material (ammunition boxes, etc.) contaminated by their association with pyrotechnic materials. Currently, hundreds of rusted 50-gallon drums of various wastes (hazardous and nonhazardous) are stacked discriminately about the area. Other miscellaneous wastes are scattered in piles across the site. Presently, there are no levees at the site to contain spills or run-on/runoff.

The site has been classified as an "open dump" by the AEHA. The site is also considered a potential health hazard, as defined by RCRA and the State of Arkansas, as chemical analysis of soil bores indicates a wide distribution of lead contamination beneath the site. Barium and cadmium are also present in lesser concentrations. In addition, the soil throughout the site is contaminated by various explosive compounds which are potential carcinogens and mutagens.

The site is believed to overlie Recent alluvium composed of fat and lean clays. These deposits rim a swampy wetland. Ground water, believed to be ±10 feet below the ground surface at the elevation of the swamp, flows northeast to the swamp and towards the Arkansas River (see Appendix B).

3.5.18.1 Assumptions

The major assumption inherent in these plans is that the clay layer found during installation of the monitoring wells at the site is pervasive, and will form a suitable foundation for shallow cutoff walls.

3.5.18.2 Run-on/Runoff Control Plan

To prevent surface migration of hazardous materials from the site, the perimeter of the site should have levees placed to divert run-on. A levee should also be constructed along the

swamp side of the site to prevent flooding of the site from the swamp and to trap rainfall falling onto the site. A small reservoir with collection trenches along the inside of the swamp side levee would be necessary to collect the trapped rainfall. The reservoir would be periodically monitored and pumped to the PBA treatment facility or directly to the swamp, depending upon its characteristics.

The basic features of the proposed run-on/runoff control plan include construction of the following:

- Diversion levees and trenches along the east, west, and southwest perimeters of the site.
- Retention levees and collection trenches along the northeast perimeter of the site.
- A retention reservoir to collect trapped rainfall.

Construction and engineering design cost estimates are shown in Table 3-19. Features of this plan are shown on Sheet 4.

Retention basin monitoring parameters will need to be developed, based on a complete analysis of soil samples from the site. Development of such a monitoring plan is beyond the scope of this study.

3.5.18.3 Closure Considerations

It is anticipated that an impervious clay layer will be encountered within a few feet of the surface at the site (see Appendix B). If geotechnical investigations bear this out, the above-discussed run-on/runoff control should prevent migration of contaminants away from the site.

To close the site, it will be necessary to eliminate entrapment of surface water (rainfall) and horizontal movement of ground water onto the site. To eliminate the horizontal movement ground water onto the site, a hydraulic clay barrier should be placed just inside the diversion levee, and trenched along the east, west, and southwest perimeters of the site. This barrier must be keyed into the same clay layer as that assumed for the retention levee. To eliminate entrapment of rainfall and to reduce its vertical movement onto the site, the following steps will be involved:

1. Remove all nonhazardous debris to a sanitary landfill or salvage.
2. Remove all containers and large pieces of contaminated debris to a proper storage, disposal, or treatment facility.

TABLE 3-19. SITE 20A COST ESTIMATE FOR IMPLEMENTATION OF PROPOSED RUN-ON/RUNOFF CONTROL SYSTEM

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation	4,170 m^3	2.50/m^3	10,425
Clearing and Grubbing	2.3 acres	1,100/acre	2,530
Berms/Levees	3,120 m^3	5.00/m^3	15,600
Swale/Channel	1,220 m	3.50/m	4,270
Gravel	625 m^3	8.00/m^3	5,000
Sand	940 m^3	8.50/m^3	7,990
Clay Liner from On-Site	1,250 m^3	5.00/m^3	6,250
Low-Permeability Fill	1,000 m^3	3.00/m^3	3,000
36-mil Reinforced Hypalon Sheeting	2,000 m^2	5.95/m^3	11,900
Fencing	185 m	40.00/m	7,400
Culvert Pipe - 18" dia	7 m	35.30/m	250
Leachate Sump and Piping	1	750 each	750
Revegetation	7,200 m^2	1.25/m^2	9,000
Topsoil	1,097 m^3	3.00/m^3	3,290
Subtotal			87,655
Engineering/Permit Fee (15% of Subtotal)			13,150
Contingencies (20% of Subtotal)			17,531
Total (1982 dollars)			118,336
Total (1983 dollars)*			130,170
Total (1984 dollars)*			143,187

* Calculated at 10 percent per year inflation.

3. Bulldoze the site to uniform contours to facilitate placement of a clay cap.

4. Place a 24-inch impervious clay cover over the site, graded to promote runoff. The cover should be keyed into the run-on/runoff levees surrounding the perimeter of the site.

5. Place topsoil over the cover and revegetate the site.

6. Set monument(s) and prepare a plot plan to delineate the closed site.

The features of the closed site are shown on Sheet 17. The cost estimate for implementation of the closure plan is presented in Table 3-20. An implementation schedule is presented in Figure 3-17.

3.5.18.4 Post-Closure Care

The site will require post-closure care and ground water monitoring. Since little or no settlement of the final cover is anticipated, maintenance requirements should be minimal. The site should be inspected semiannually for 3 years, and annually thereafter. Maintenance would be scheduled in response to any damages noted during inspection. A ground water monitoring system has been installed and a monitoring plan implemented for this site. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $15,000 (1984 dollars).

3.5.18.5 Additional Investigations

None.

3.5.19 Site 23a, White Smoke Test Pond

Site 23a, the white smoke test pond, is used for testing smoke pots and grenades. Spent munitions resulting from these activities and other waste materials are deposited at the site. Previous investigations revealed that the soils at this site are contaminated with arsenic, lead, and mercury. Characteristics of the sludge and wastewater contained in this 1.5-acre test pond are unknown. Reportedly, the pH of the water in the pond is relatively low.

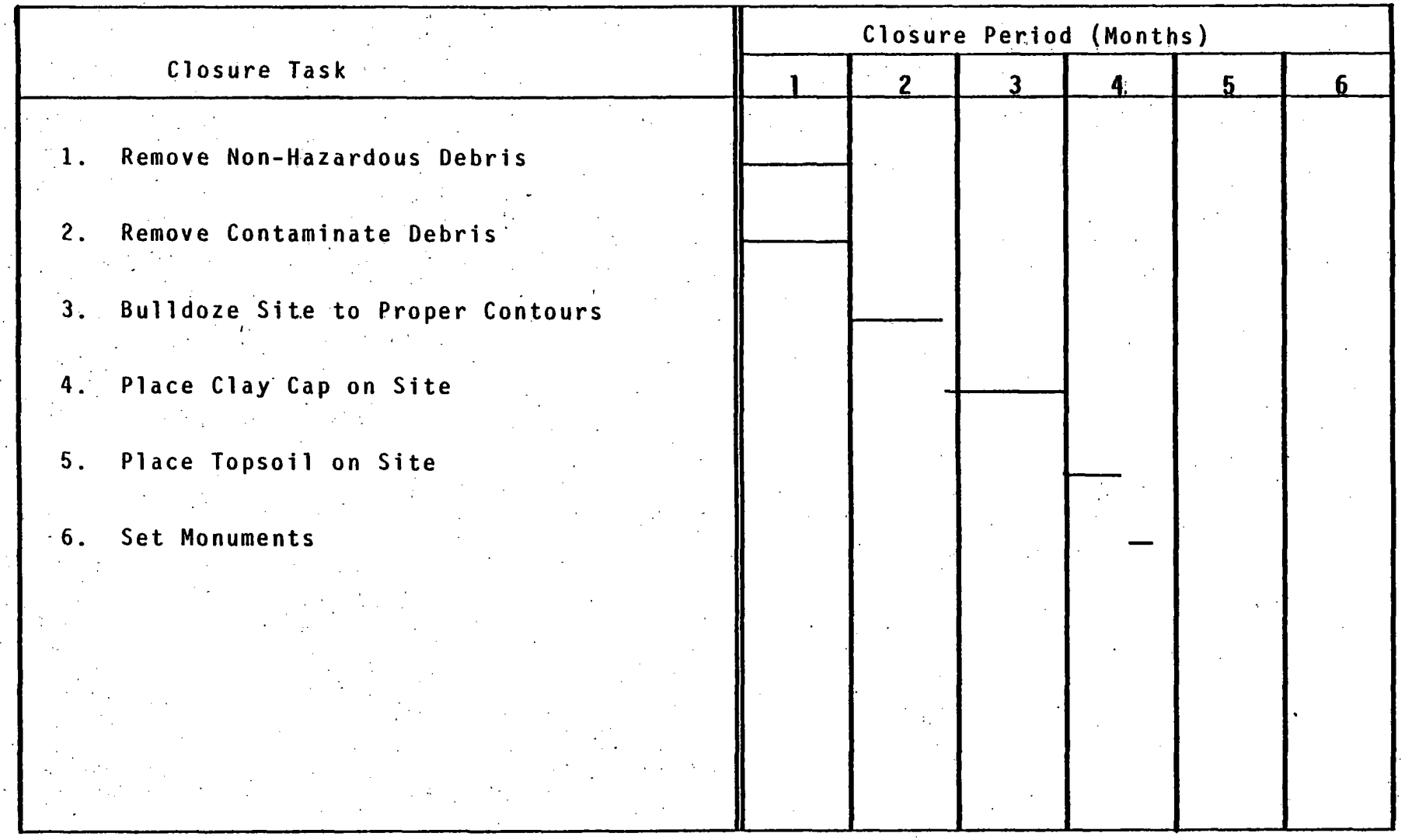
The site is underlain by stratified sandy and clayey soils with multiple saturated zones and a relatively shallow perched water table. Sandy and clayey soils are exposed in the banks and along the shore of the pond. Thus, it appears likely that at least the upper perched portion of the water table is contaminated due to hydraulic loading from the pond. A generalized description of the site geology is presented in Appendix B.

TABLE 3-20. SITE 20A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Earth Movement/Grading	19,260 m^3	2.50/m^3	48,150
Low-Permeability Fill	38,520 m^3	3.00/m^3	115,560
Topsoil	19,250 m^3	3.00/m^3	57,780
Revegetation	63,200 m^2	1.25/m^2	79,000
Subtotal			300,490
Engineering/Permit Fee (15% of Subtotal)			45,075
Contingencies (20% of Subtotal)			60,100
Total (1982 dollars)			405,665
Total (1983 dollars)*			446,230
Total (1984 dollars)*			490,855

* Calculated at an inflation rate of 10 percent per year.

Figure 3-17. Site 20a, proposed closure implementation schedule.



3.5.19.1 Assumptions

The proposed closure scenario is based on the following assumptions:

- The sludge and contaminated soil at the site were found to be a hazardous waste. (Its classification as a non-hazardous waste site by AEHA is based on a single grab sample that indicated the material to be marginal. Facility investigations suggest relatively widespread heavy metal contamination based on total concentrations.)

- The shallow perched water table underlying the site is contaminated due to recharge from the test pond.

- The test pond itself provides a source of leachate to the surrounding soil. Due to low pH conditions, the heavy metal contaminants are relatively mobile.

- The site is underlain by a natural clay layer or series of clay layers of adequate extent and thickness to provide a key for the cutoff wall (see Appendix B).

- Ultimately, the hydrologic balance for the closed site will become stabilized due to the hydraulic barriers and evapotranspiration so that leachate collection and treatment can be discontinued. Alternatively, the characteristics of the leachate will moderate with time so that it may be discharged overboard.

3.5.19.2 Closure Considerations

Based on the available data, closure of the white smoke test pond will involve the following actions:

1. Construct temporary SRB's.

2. Decant the fluid in the pond, and transport it to the PBA pollution abatement facility for treatment.

3. Install a hydraulic barrier around the entire site, and key into the shallowest pervasive clay layer suitable for providing a horizontal hydraulic barrier.

4. Install a sump or series of sumps within the barrier and dewater the contaminated area to the extent possible. A permanent sump should be installed near the lowest point along the hydraulic barrier and connected to the nearest industrial sewer.

5. Grub the site and burn the organic materials inside the area contained by the hydraulic barrier. Spread and compact the ashes over a sufficient area so as not to exceed a maximum thickness of 6 inches.

6. Grade the entire site by cut-fill and placement of fill to prevent run-on and to promote runoff.

7. Place select fill as shown on Sheet 10 to complete the leachate collection system; then construct the collection basin.

8. Cover all areas within the hydraulic barrier with 2 feet of compacted natural silty clay to provide a final cover (three lifts of 8-inch compacted thickness).

9. Place topsoil on all disturbed areas and revegetate the site.

10. Set monument(s) to delineate the location of the closed site.

One of the key features of the proposed closure scenario is the use of hydraulic barriers and the sump as a gravity leachate collection system. Although this recommendation appears warranted by the existing site conditions, it needs to be carefully evaluated during final design. A plan and typical profile of the closed site are shown on Sheet 8. Estimated closure costs are presented in Table 3-21, and an implementation schedule is presented in Figure 3-18.

3.5.19.3 Post-Closure Care

Since hazardous material will remain after closure, ground water monitoring and post-closure care will be required. Post-closure care requires monitoring of all structures developed during site closure to permit maintenance to be scheduled as warranted. An inspection form is presented in Table 4-1. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $12,000 (1984 dollars).

A piezometer net will be required to monitor the effectiveness of the proposed hydraulic barrier and leachate collection system. Such installation should be considered supplemental to the existing ground water monitoring system, and can only be designed subsequent to the detailed site and subsurface investigations required for final design of the closure plan. It should, however, permit assessment of hydraulic heads across the cutoff wall at several locations, and allow similar monitoring of heads above and below the natural clay layer into which the proposed cutoff walls are keyed. This is the only means of monitoring the effectiveness of these hydraulic barriers.

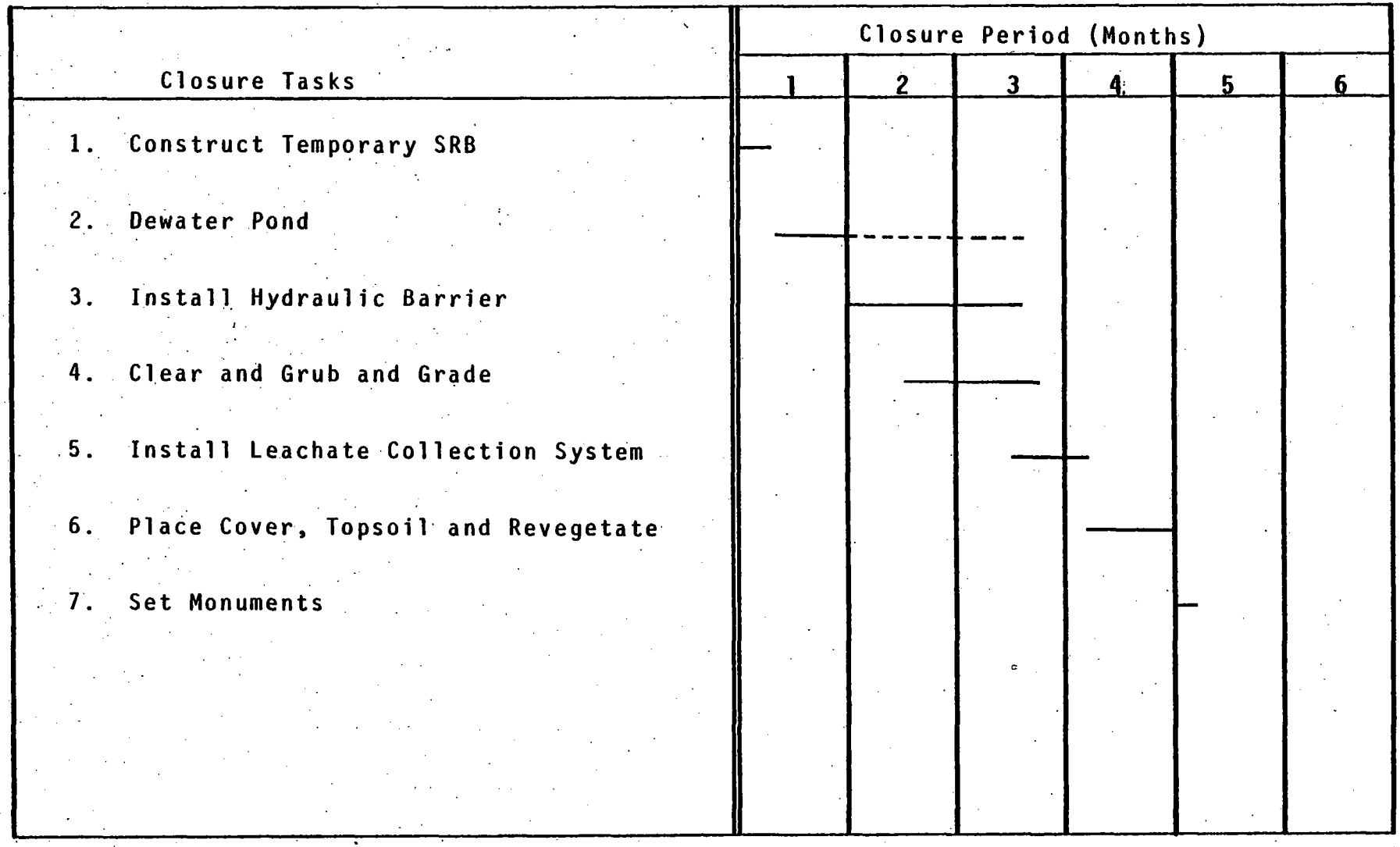
The site should be inspected quarterly for at least 4 years, or longer if necessary, until an adequate body of data is developed to permit long-range decisions to be made regarding leachate collection and treatment, as well as hydraulic budget predictions. At least one monitoring well should be located within the

TABLE 3-21. SITE 23A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	57,490 m^2	0.27/m^2	15,520
Trenching	340 m^3	3.83/m^3	1,300
Earth Movement/Grading of Contaminated Material	7,810 m^3	3.25/m^3	25,380
Ordinary Fill	6,850 m^3	3.00/m^3	20,550
Low-Permeability Fill	30,590 m^3	3.00/m^3	91,770
Berms/Levees	40 m^3	5.00/m^3	200
Leachate Collection System	1	570 ea	570
4" PVC Pipe	300 m	5.45/m	1,600
Slurry Trench	3,190 m^3	560.00/m^3	1,786,400
Wastewater Removal/Treatment	6,060 m^3	0.18/m^3	1,090
Revegetation	57,490 m^2	1.25/m^2	71,860
Topsoil	17,480 m^3	3.00/m^3	52,440
Subtotal			2,068,680
Engineering/Permit Fee (15% of Subtotal)			310,300
Contingencies (20% of Subtotal)			413,735
Total (1982 dollars)			2,792,715
Total (1983 dollars)*			3,071,985
Total (1984 dollars)*			3,379,185

* Calculated at an inflation rate of 10 percent per year.

Figure 3-18. Site 23a, proposed closure implementation schedule.



most heavily contaminated portion of the site to provide baseline data for the assessment of continued leachate collection. Such monitoring wells can be installed if properly sealed to prevent vertical migration of potential contaminants.

3.5.19.4 Additional Investigations

Prior to final design of the closure plan for Site 23a, it will be necessary to complete detailed site and subsurface investigations. The purposes of these investigations are as follows:

- Determine the nature and severity of the waste and resultant contamination.
- Develop an understanding of the site's subsurface and hydrogeologic conditions in order to permit an assessment of the proposed closure scenario.
- Better delineate the depth and extent of contamination.
- Permit a thorough evaluation of existing and potential contaminant migration pathways.
- Permit an overall evaluation of the feasibility of the proposed closure scenario, and permit its modification if warranted.

The proposed closure scenario incorporates a number of conservative features designed to halt leachate migration. These appear warranted by the unusual configuration of the site and the relatively low pH conditions of the water in the test pond. During final design of the closure plan, their need should be carefully reevaluated. If these assumptions prove to be incorrect, the closure options would be considerably more straightforward, and would probably involve draining and capping the pond. Further, the post-closure requirements would become trivial.

It is recommended that a number of closely spaced additional monitoring wells penetrating only the perched zone (as revealed by monitoring wells 147, 149, and originally 148) be installed at the earliest opportunity.

Data from these shallow wells will provide baseline data to determine if leachate is migrating. If it is not, items 2, 3, 5, and 9 can be eliminated from the proposed closure plan, substantially reducing the cost of the plan. The same course can be followed if the sludge and contaminated soils are found to be nonhazardous.

3.5.20 Site 24, Thermite Disposal Area

The thermite disposal area, presently classified as an open dump, is used for disposal of thermite waste generated by the quality assurance drop tower and lead oxide waste from the bomb

washout facility. Previous investigations at this 4-acre site revealed that a significant portion was contaminated with heavy metals, including barium, lead, and mercury. The areal extent of contamination appears to have been relatively well defined. Contamination was detected at the maximum depths sampled (approximately 10 feet).

Four monitoring wells have recently been installed near the site, and a monitoring plan has been developed in accordance with RCRA requirements. Logs of these holes indicate that the site is underlain by stratified granular and clayey soils, and the depth to static ground water ranges from 27 to greater than 30 feet (see Appendix B). The drilling notes indicate that a shallow perched zone was encountered in the vicinity of the site; this saturated zone may be seasonal.

3.5.20.1 Assumptions

The major assumptions used in developing this closure plan are as follows:

- The site's subsurface conditions are substantially revealed by the four widely spaced borings made for monitoring well installation.
- The areal extent of contamination resulting from past and ongoing use of the site has been adequately defined, despite uncertainties regarding the depth of contamination.
- Contamination has not penetrated to the uppermost (probably perched) water table; thus, no ground water contamination plumes exist.
- The uppermost aquifer, excluding the perched water table, is partitioned from the contaminated area by a layer of low-permeability natural silty clay.
- Variations in seasonal water table elevation do not substantially change the conditions assumed above.
- The existing 18-inch-diameter, vitrified clay sewer pipe crossing beneath the southern portion of the site is in good condition (i.e., not leaking).

3.5.20.2 Closure Considerations

Based on the available information, it is recommended that the thermite disposal area be closed in situ as though it were a landfill. Closure will involve the following actions:

1. Construct temporary SRB's.
2. Grade the site in preparation for cover placement.

3. Place a final cover comprised of native silty clay and compact over the prepared site.

4. Delineate the site by means of permanent monuments, survey the monuments, and prepare a plot plan.

5. Place topsoil on all disturbed areas, and revegetate the site.

6. Once vegetation has been reestablished, clean and demolish the sedimentation basins. The material should be removed to either a sanitary landfill or secure landfill, as appropriate.

The major components of the recommended closure plan are shown on Sheet 7. Estimated implementation costs are presented in Table 3-22. A proposed implementation schedule is presented in Figure 3-19.

3.5.20.3 Post-Closure Care

Since hazardous waste will remain at the site after closure, a post-closure plan and ground water monitoring will be required. A ground water monitoring system has been installed and a monitoring plan implemented at this site. During the closure period, the site will need to be maintained to preserve the integrity of the run-on/runoff control features and cover installed during closure. This maintenance should be scheduled in response to observed conditions and/or ground water monitoring data. We recommend that the site be inspected at least annually for 4 years subsequent to closure, and at least once every 2 years thereafter. An inspection form is presented in Table 4-1. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $2,000 (1984 dollars).

3.5.20.4 Additional Investigations

Sufficient exploratory investigations should be completed to substantiate the assumptions made herein prior to final design of the closure plan. Test borings and test pits should be made to reveal the site's actual subsurface and hydrogeologic conditions, and to obtain samples for chemical analysis to better delineate the depth and extent of contamination. If conditions substantially different from those assumed are encountered, the recommended plan should be reevaluated.

3.5.21 Site 27, Agent BZ Pond

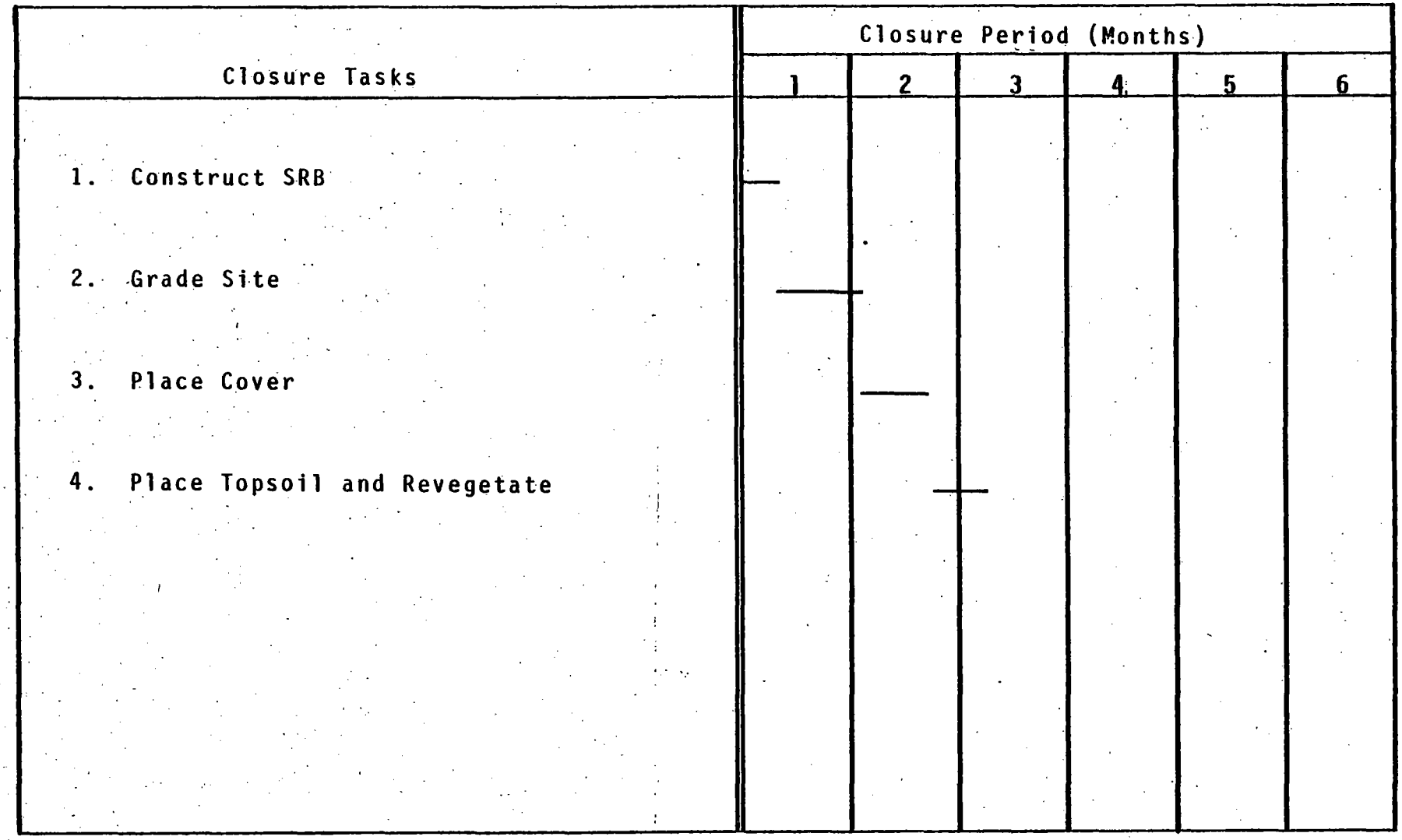
The Agent BZ pond site is comprised of an unlined, 1/4-acre lagoon and the immediate surrounding area. The lagoon received the following wastes while in use: decontaminated Agent BZ, impregnite, thermite, and lead oxide (bomb washout of starter mix). Soil bores indicate that anomalous concentrations of lead,

TABLE 3-22. SITE 24 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	30,970 m^2	0.27/m^2	8,360
Ordinary Fill	9,410 m^3	3.00/m^3	28,230
Low-Permeability Fill	14,780 m^3	3.00/m^3	44,340
Berms/Levees	30 m^3	5.00/m^3	150
Swale/Channel	220 m	3.50/m	770
Riprap	280 m^3	25.00/m^3	7,000
Revegetation	30,970 m^2	1.25/m^2	38,710
Topsoil	7,390 m^3	3.00/m^3	22,170
Subtotal			149,730
Engineering/Permit Fee (15% of Subtotal)			22,460
Contingencies (20% of Subtotal)			29,945
Total (1982 dollars)			202,135
Total (1983 dollars)*			222,350
Total (1984 dollars)*			244,585

* Calculated at an inflation rate of 10 percent per year.

Figure 3-19. Site 24, proposed closure implementation period.



barium, and zinc are found at this site. Contamination appears to be restricted to the upper 3 feet of the soil profile. The area of contamination is confined to an area of less than 1.5 acres, including the lagoon. Considered a hazardous waste site and lagoon by RCRA definition, the site is believed to be situated over Pleistocene terrace materials. A generalized description of the site's geologic conditions is presented in Appendix B.

3.5.21.1 Assumptions

None.

3.5.21.2 Closure Considerations

To properly close the site, it will be necessary to develop the existing lagoon into a hazardous waste landfill. The following steps should be taken to close the site:

1. Construct diversion trenches around the contaminated area to divert runoff from entering the area. The trenches should drain to the existing creek just north of the site.

2. Remove all dewatered, nonhazardous debris to a sanitary landfill.

3. Analyze the standing water in the lagoon for contamination. If contaminated, the liquid should be transported to the PBA treatment facility for disposal. If the liquid is judged safe for discharge, it can be pumped into the small creek north of the lagoon.

4. Excavate the lagoon bottom sludge and side walls, and stockpile this material. A minimum of 3 feet of overexcavation is recommended. (Soil samples should be taken at this point to determine if all contaminated material has been removed from the immediate vicinity of the lagoon.)

5. Line the expanded lagoon site with an impermeable liner (24 inches of compacted clay).

6. Place the excavated material in the lined lagoon. Excavate the 3 feet of contaminated soil found in the contaminated area, and place in the lined basin. All soil/sludge material placed in the lagoon should be spread in thin lifts and compacted.

7. Place a 24-inch impervious silty clay cover over the lined area, and grade to promote runoff.

8. Place 12 inches of native topsoil over the cover and disturbed areas, and revegetate the site.

9. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The features of the closed site are shown on Sheet 18. A cost estimate for implementation of the closure plan is presented in Table 3-23. An implementation schedule is presented in Figure 3-20.

3.5.21.3 Post-Closure Care

The site will require post-closure care and maintenance in accordance with the standards applicable to hazardous waste landfills. Since little or no settlement of the final cover is anticipated, semiannual inspections for the first 3 years, followed by annual inspections thereafter, appear adequate. Maintenance would be scheduled in response to damage noted during the inspections. A site inspection form is presented in Table 4-1.

The anticipated level of maintenance should be minimal. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $3,000 (1984 dollars). Ground water monitoring is required. A ground water monitoring system and a monitoring plan have been implemented for this site.

3.5.21.4 Additional Investigations

None.

3.5.22 Site 2, Webster Road Test Site

Site 2, the Webster Road test site, was used for testing DM, CM, and manganese grenades from 1944 to 1948. During site reconnaissance, a small pile of rusty grenade canisters and residue was observed. The area had been recently graded, as evidenced by a disturbed area and crawler vehicle tracks. Thus, its original extent could not be determined. Previous investigations indicated that limited areas of contaminated soils were found at this site. Sandy soils are exposed at the surface. A generalized description of the site geology is presented in Appendix B.

3.5.22.1 Assumptions

None.

3.5.22.2 Closure Considerations

Considering the small size of Site 2 and the sandy nature of the surficial soils, it appears that the most effective means of closure would be to remove waste materials to a secure landfill.

Closure of this site will require the following actions:

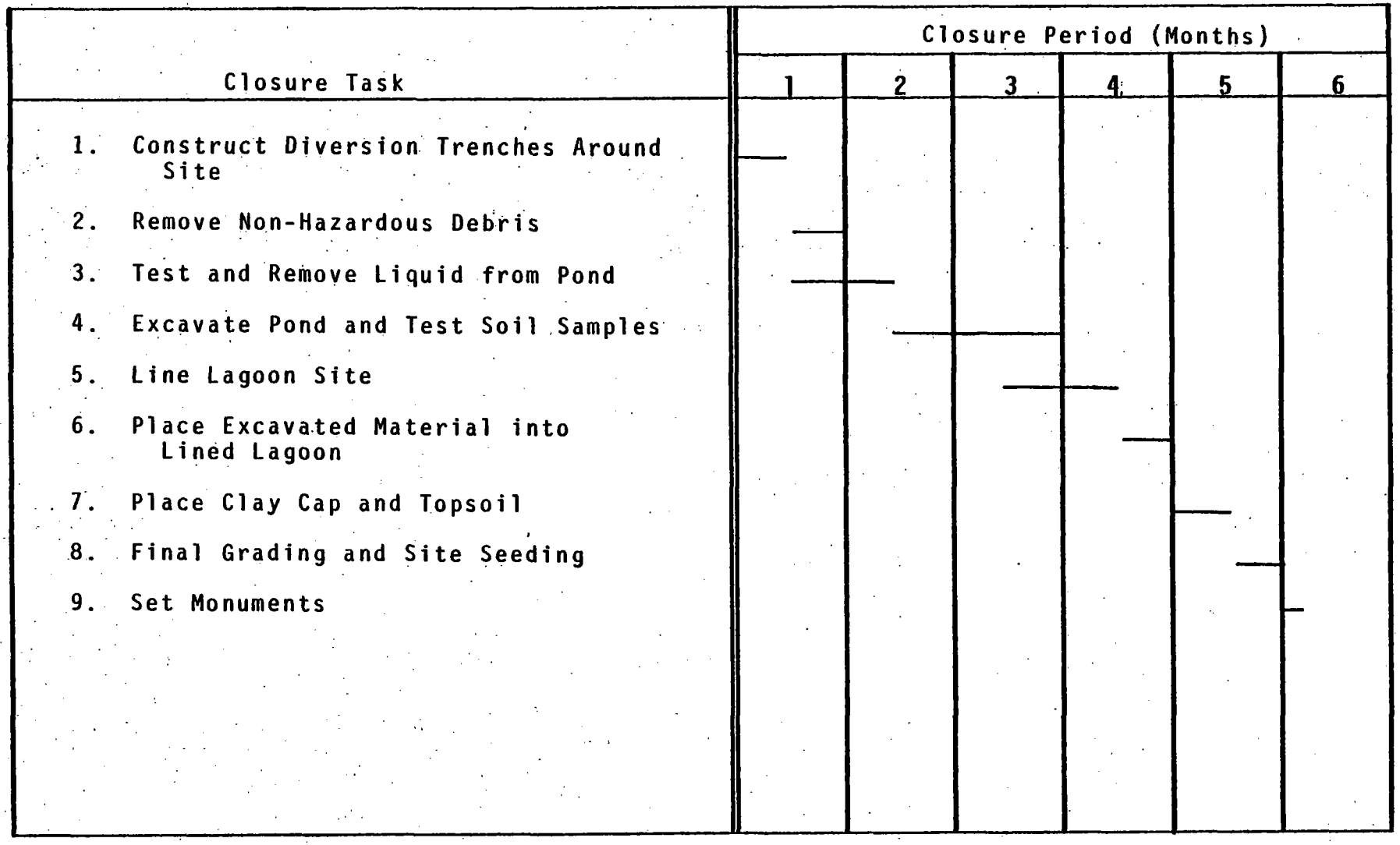
1. Excavate the waste materials and contaminated soils and transport to a secure site.

TABLE 3-23. SITE 27 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation of Contaminated Material	1,400 m^3	4.07/m^3	5,700
Low-Permeability Fill	9,780 m^3	3.75/m^3	36,675
Swale/Channel	1,630 m	4.38/m	7,140
Revegetation	13,940 m^2	1.56/m^2	21,750
Topsoil	4,250 m^3	3.75/m^3	15,940
Sample Analysis	20	200.00 ea	4,000
Subtotal			91,205
Engineering/Permit Fee (15% of Subtotal)			13,680
Contingencies (20% of Subtotal)			18,240
Total (1982 dollars)			123,125
Total (1983 dollars)*			135,438
Total (1984 dollars)*			148,982

* Calculated at an inflation rate of 10 percent per year.

Figure 3-20. Site 27, proposed closure implementation schedule.



2. Backfill and grade the disturbed areas.

3. Revegetate the disturbed areas.

Cost estimates for implementation of the recommended closure plan are presented in Table 3-24. Site grading details and proposed excavation limits are shown on Sheet 12. A proposed implementation schedule is presented as Figure 3-21.

3.5.22.3 Post-Closure Care

Since no hazardous waste will remain at the site after closure, only minimal care will be required. Ground water monitoring will not be required. The site should be inspected periodically to assure that it is properly revegetated. Winter or storm damage noted during inspections should be repaired.

3.5.22.4 Additional Investigations

Prior to backfilling the excavation and regrading the site, several soil samples should be taken for chemical analysis to determine if all contaminated soil has been removed.

3.5.23 Site 4a, 504th Street Burning Ground

Site 4a, the abandoned 504th Street burning ground, was used for burning explosives and other munitions-related wastes. Although previous investigations identified a number of contaminants present in the subsoil, such occurrences appeared to be sporadic, rather than pervasive across the 4-acre site. For instance, 92 bores were made for the purpose of obtaining soil samples for chemical analysis with the following results:

- Anomalous concentrations of arsenic were found in one bore.
- Anomalous concentrations of barium were found in three bores.
- Anomalous concentrations of lead were found in only four bores.
- Anomalous concentrations of mercury were found in 19 bores.
- Isomers of DDT were found in varying concentrations throughout the site's subsoils.

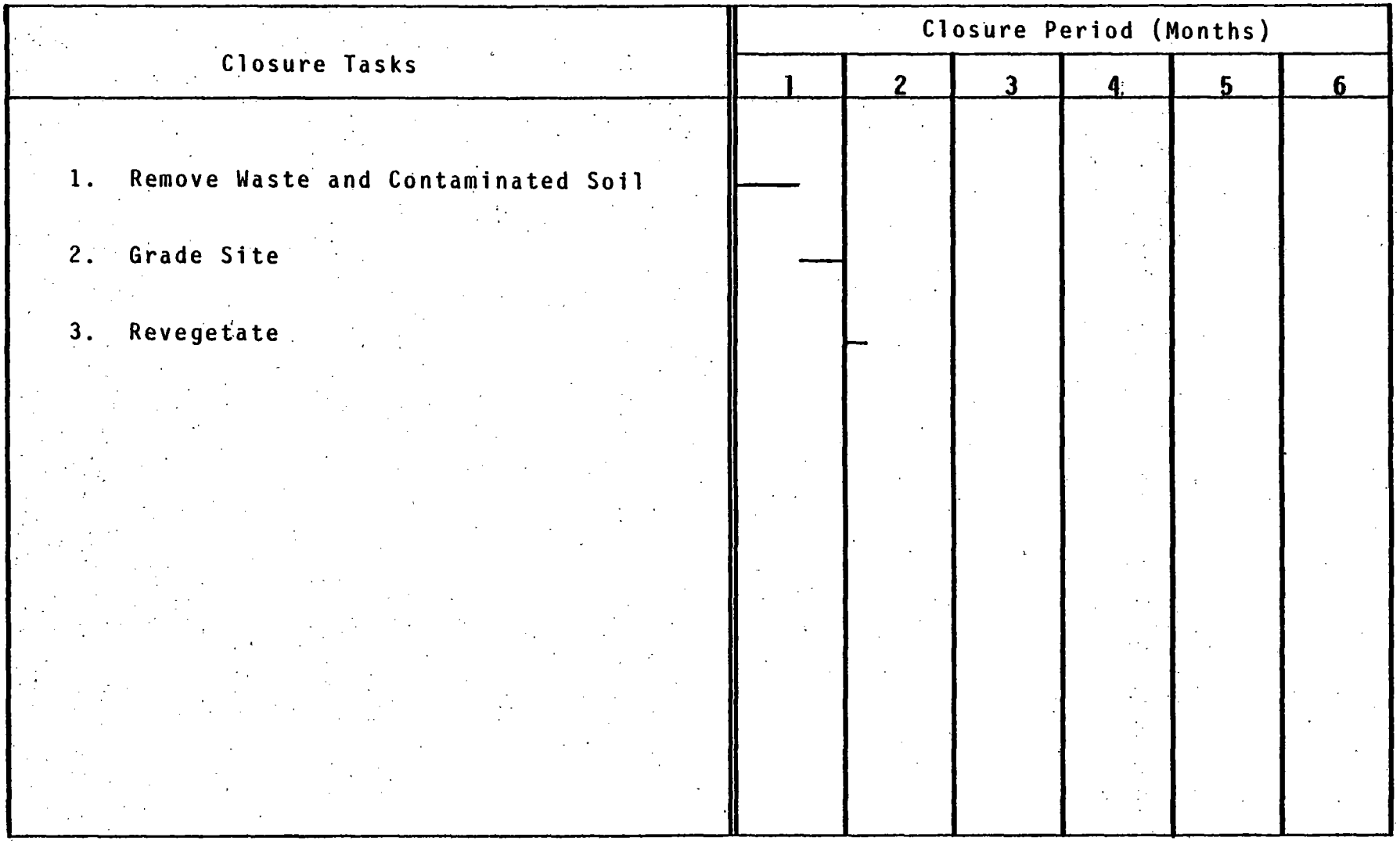
During site reconnaissance, it was noted that the site has not become revegetated. However, portions of the site appeared to have been recently graded. It was thus difficult to ascertain the actual condition and/or extent of distressed vegetation. A general description of the site's subsurface conditions is presented in Appendix B.

TABLE 3-24. SITE 2 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	2,430 m^2	0.27/m^2	655
Excavation of Contaminated Material	13,290 m^3	3.25/m^3	43,195
Low-Permeability Fill	12,690 m^3	3.00/m^3	38,070
Berms/Levees	38 m^3	5.00/m^3	190
Revegetation	2,430 m^2	1.25/m^2	3,040
Topsoil	740 m^3	3.00/m^3	2,220
Subtotal			87,370
Engineering Permit Fee (15% of Subtotal)			13,105
Contingencies (20% of Subtotal)			17,475
Total (1982 dollars)			117,950
Total (1983 dollars)*			129,745
Total (1984 dollars)*			142,720

* Calculated at an inflation rate of 10 percent per year.

Figure 3-21. Site 2, proposed closure implementation schedule.



3.5.23.1 Assumptions

The recommended closure scenario is based on the following assumptions:

- The contaminated soils are hazardous wastes.
- The site is underlain by soils with a high cation exchange capacity which effectively adsorbs the observed levels of heavy metal contamination; thus, it is suitable to close the site in situ from a hydrogeologic standpoint.
- Ground water (including perched zones) is deeper than the heavy metal contamination, thus reducing the potential for contaminant migration.
- Heavy metal concentrations do not drastically increase below the depth of exploration of the previous investigations.

3.5.23.2 Closure Considerations

Based on our understanding of Site 4a's conditions and the delineated assumptions, it is recommended that the site be closed in situ. Closure of Site 4a will involve the following actions:

1. Construct temporary SRB's to prevent siltation during site closure.
2. Install perimeter ditch along the southeast boundary of the site to prevent run-on and to intercept runoff. The ditch should be routed through the SRB.
3. Remove the sparse vegetation found on site. This activity should be undertaken in a manner that will minimize disturbance of the site's exposed soils. This vegetation should be piled at a central location on the site and burned.
4. Grade the site properly.
5. Place an impervious surface cover of native silty clay, and compact properly to minimize infiltration. It should be graded to promote runoff, as shown on Sheet 21. (Note: The ashes remaining from burning the vegetation should be spread into a layer approximately 6 inches thick and compacted prior to placement of the cover to prevent excessive settlement and resultant damage to the cover.)
6. Cover disturbed area with topsoil and revegetate the site.

7. Delineate the site in the field by means of permanent monuments. Prepare a plot plan, and enter into the registry of deeds.

8. Test the contents of the SRB, and remove wastes to a secure landfill if they prove to be hazardous. The SRB should be left in place until vegetation has been fully reestablished.

The features of the proposed closure plan are shown on Sheet 19. Closure cost estimates are presented in Table 3-25, and a proposed implementation schedule is shown in Figure 3-22.

3.5.23.3 Post-Closure Care

Since hazardous material will remain at the site after closure, post-closure care will be governed by the standards applicable to land disposal sites. Ground water monitoring will be required; however, development of a ground water monitoring plan is beyond the scope of this study. Its development should proceed directly from completion of the recommended design-level investigations.

Other aspects of post-closure care should be minimal throughout the closure period once revegetation is successful. Inspections should be conducted annually for 3 years, and biannually thereafter. Maintenance should be scheduled in response to observed damage to the cover, vegetation distress, or other factors. A site inspection form is presented in Table 4-1.

The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $6,000 (1984 dollars).

3.5.23.4 Additional Investigations

The uncertainties described under the assumptions need to be resolved prior to final design. Investigations should be completed to delineate the extent of contamination and the site's relevant subsurface and hydrogeologic conditions.

3.5.24 Site 12, Old Mustard Dump Site

The old mustard dump site is located southeast of the bombing mat near the Arkansas River. The actual extent of the contaminated area is unclear. One area is approximately 150 feet long and 50 feet wide, and exhibits contamination resulting from the disposal of munitions. Other trenches exist in this area, but whether or not they were ever used as disposal sites is unknown. After World War II, captured munitions were burned in this area.

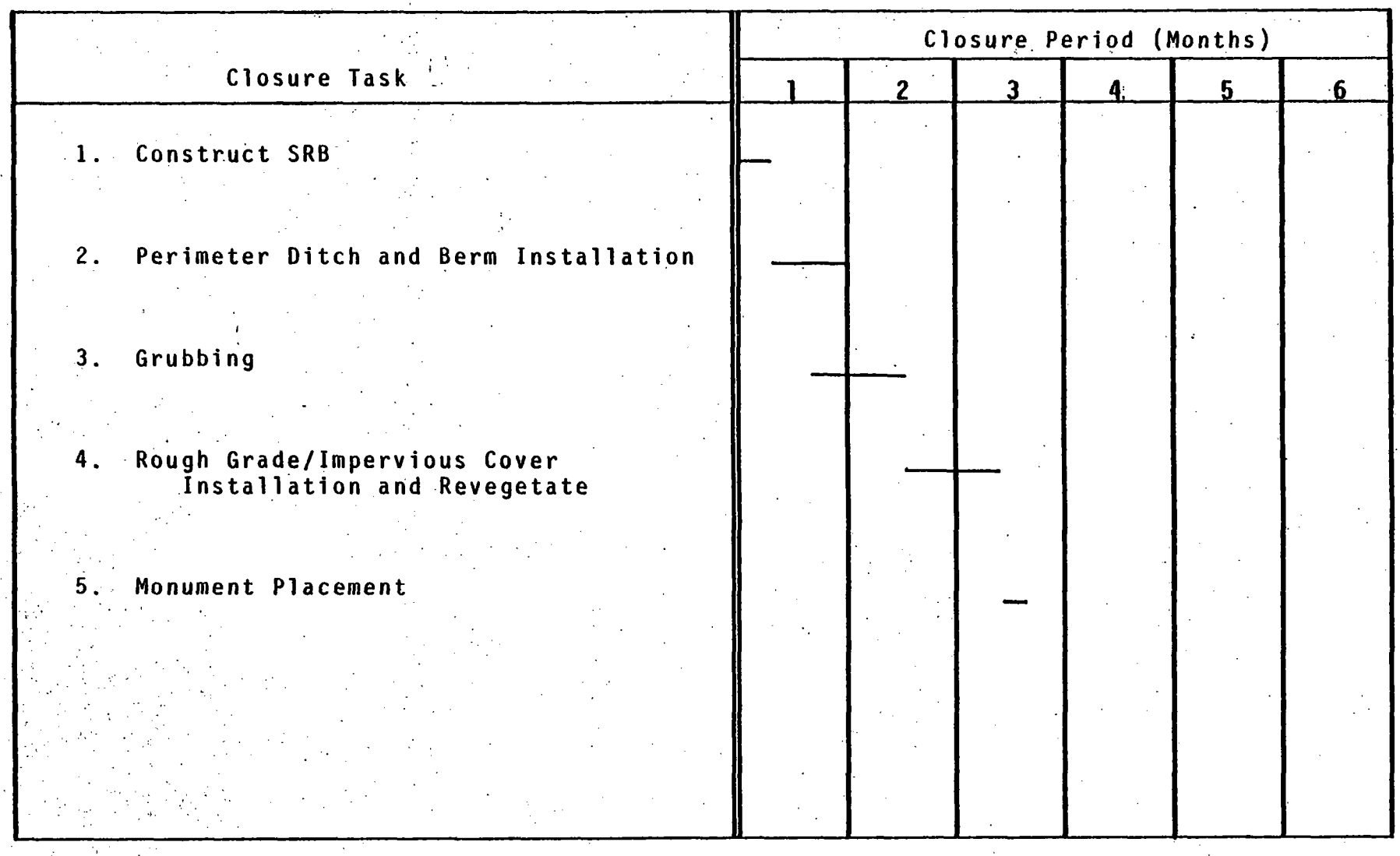
During site reconnaissance, several locations exhibiting "dead" spots and/or rusted drums, munitions casings, and other debris were observed.

TABLE 3-25. SITE 4A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clear and Grubbing	69,600 m^2	0.23/m^2	16,010
Ordinary Fill	21,300 m^3	3.00/m^3	63,900
Low-Permeability Fill	42,300 m^3	3.00/m^3	126,900
Berms/Levees	70 m^3	4.25/m^3	300
Swale/Channel	570 m	2.98/m	1,700
Revegetation	69,600 m^2	1.06/m^2	73,775
Topsoil	21,300 m^3	2.55/m^3	54,315
Subtotal			336,900
Engineering/Permit Fee (15% of Subtotal)			50,535
Contingencies (20% of Subtotal)			67,380
Total (1982 dollars)			454,815
Total (1983 dollars)*			500,295
Total (1984 dollars)*			550,325

* Calculated at an inflation rate of 10 percent per year.

Figure 3-22. Site 4a, proposed closure implementation schedule.



Site 12 is located adjacent to the Arkansas River. Considerable portions of the site lie in the river's floodplain and/or below PBA's 100-year flood level (elevation 226 feet). The waste material remaining at the site has likely been subjected to repeated inundation and/or saturation since placement began in the early 1940's. A generalized description of the site's geologic conditions is given in Appendix B.

3.5.24.1 Assumptions

The recommended closure plan is based on the following assumptions:

- The site is not a hazardous waste facility, assuming that surficial debris is cleaned up.
- The soil at this site possesses a high cation exchange capacity which effectively adsorbs the observed heavy metal contamination.

3.5.24.2 Closure Considerations

Closure of Site 12 will involve the following actions:

1. Clean up surficial debris and dispose in a sanitary or secure landfill, as appropriate. Any munitions found should be incinerated.
2. Backfill trenches and other excavations with native soil.
3. Spread topsoil, grade to match the natural contours, and revegetate the site.

The features of the proposed closure plan are shown on Sheet 5, and estimated closure costs are shown in Table 3-26. An implementation schedule is presented in Figure 3-23.

3.5.24.3 Post-Closure Care

Since no hazardous materials will remain after closure, ground water monitoring and post-closure care will not be required. The site should be inspected periodically to assure that revegetation is successful.

3.5.24.4 Additional Investigations

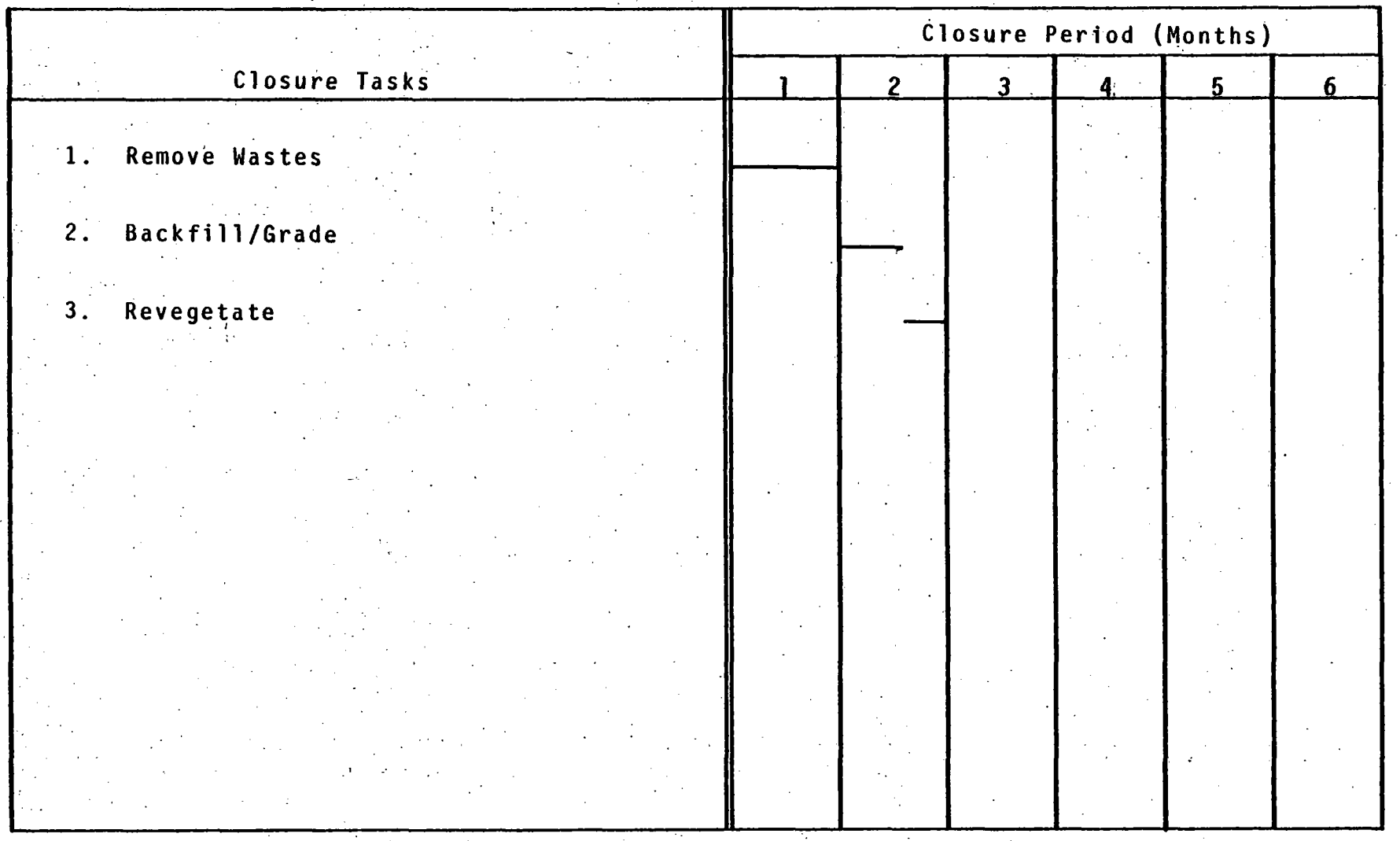
Prior to final design of the closure plan, additional investigations should be completed to confirm the assumptions upon which the closure plan is based.

TABLE 3-26. SITE 12 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clear and Grubbing	10,120 m^2	0.34/m^2	3,440
Low-Permeability Fill	6,510 m^3	3.75/m^3	24,415
Revegetation	10,120 m^2	1,56/m^2	15,785
Topsoil	3,000 m^3	3.75/m^3	11,250
Subtotal			54,890
Engineering/Permit Fee (15% of Subtotal)			8,235
Contingencies (20% of Subtotal)			10,980
Total (1982 dollars)			74,105
Total (1983 dollars)*			81,515
Total (1984 dollars)*			89,665

* Calculated at an inflation rate of 10 percent per year.

Figure 3-23. Site 12, proposed closure implementation schedule.



3.5.25 Site 13a, McCoy Road Burning Site

The abandoned McCoy Road burning site is approximately 12 acres in extent. The site has become partially revegetated since its use was discontinued, although a number of dead spots and areas with distressed vegetation were noted during the site reconnaissance. Ashes were observed in some of these dead spots. Generally, however, substantial quantities of waste material were not observed at this site. Previous investigations found minor heavy metal (lead and zinc) and DDT contamination at the site. A generalized description of the site's geologic conditions is given in Appendix B.

3.5.25.1 Assumptions

The recommended closure plan is based on two assumptions:

- The contaminated soils remaining at the site pose no unusual environmental dangers.
- The site is not a hazardous waste facility.

3.5.25.2 Closure Considerations

Closure of this site will involve the following actions:

1. Construct temporary SRB's around the site periphery.
2. Grub the site and burn the vegetation.
3. Grade the site and place compacted fill to enhance runoff.
4. Place an impervious cover of native silty clay over the entire contaminated area.
5. Spread topsoil over disturbed areas and revegetate.
6. Set monument(s) and prepare a plot plan to delineate the closed site. (Although not a requirement, the delineation of the site in this manner is recommended.)

The closure plan is portrayed on Sheet 20. Cost estimates for its implementation are presented in Table 3-27, and a proposed implementation schedule is presented in Figure 3-24.

3.5.25.3 Post-Closure Care

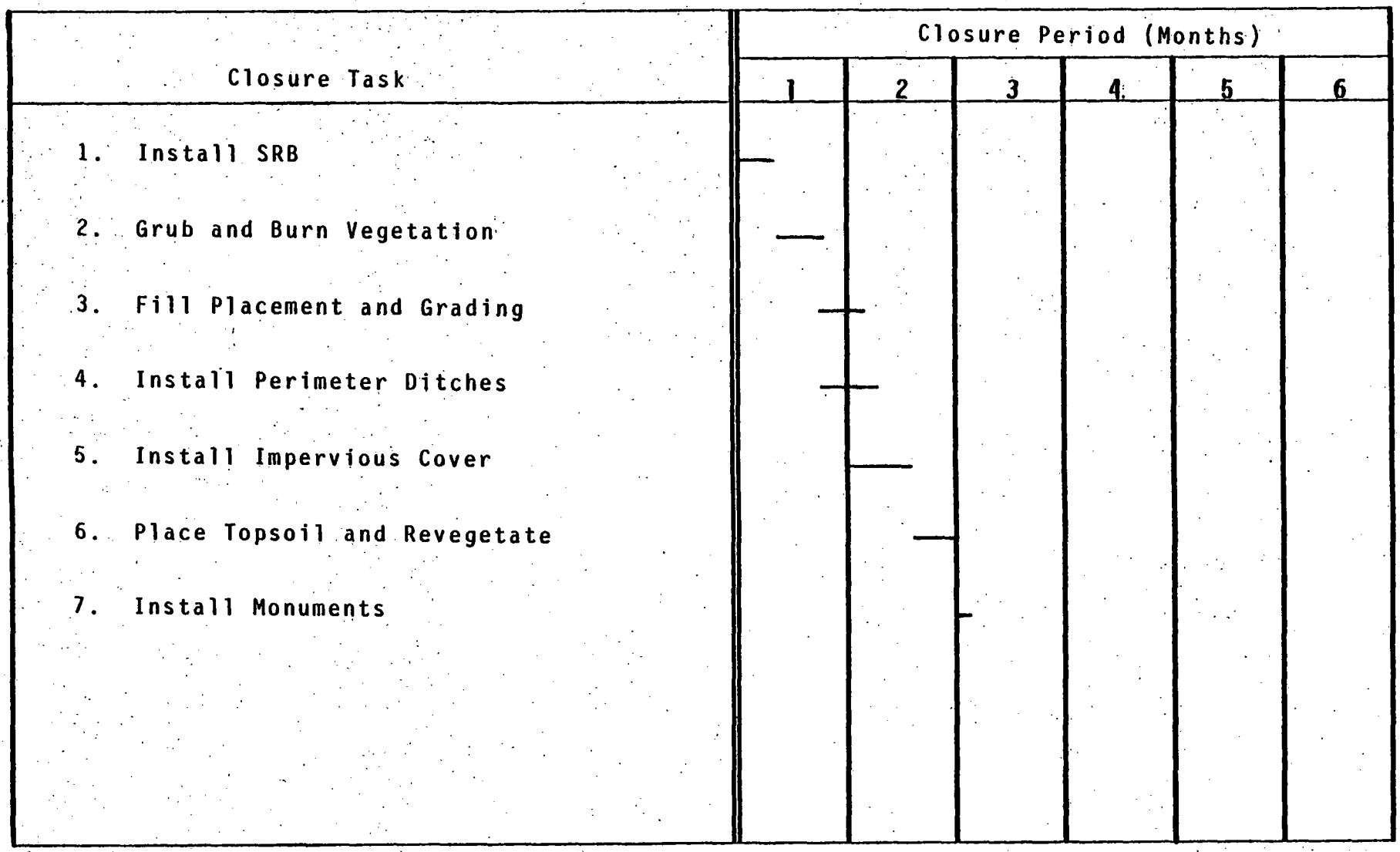
During the closure period, the site should be inspected annually for 3 years, and biannually thereafter. Maintenance should be scheduled in response to damage or erosion noted during the inspections. An inspection form is presented in Table 4-1. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is

TABLE 3-27. SITE 13A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	51,400 m^2	0.23/m^2	11,820
Ordinary Fill	26,990 m^3	2.55/m^3	68,825
Low-Permeability Fill	31,120 m^3	2.55/m^3	79,355
Berms/Levees	240 m^3	4.25/m^3	1,020
Revegetation	51,400 m^2	1.06/m^2	54,480
Topsoil	15,560 m^3	2.55/m^3	39,680
Subtotal			255,180
Engineering/Permit Fee (15% of Subtotal)			38,275
Contingencies (20% of Subtotal)			51,035
Total (1982 dollars)			344,490
Total (1983 dollars)*			378,940
Total (1984 dollars)*			416,835

* Calculated at an inflation rate of 10 percent per year.

Figure 3-24. Site 13a, proposed closure implementation schedule.



approximately $4,000 (1984 dollars). Ground water monitoring is not required at this site.

3.5.25.4 Additional Investigations

The assumption that this site is a nonhazardous waste facility should be verified.

3.5.26 Site 16a, White Phosphorus Setting Pond and Landfill

The white phosphorus settling pond, now abandoned, was constructed as a flow-through basin receiving phosphorus-laden wastewaters from production areas. Its use terminated in 1978, and it has subsequently been covered over with soil and rock material. Unknown quantities of highly reactive phosphorus are suspected to remain at the site. Observations of strong chemical reactions were made during drilling and sampling operations associated with previous investigations, and spontaneous fires have reportedly occurred at the site.

A small stream flows along the edge of the site. The ground water table is probably relatively shallow.

Some heavy metal contamination was detected at the site during previous investigations. Mercury and lead were found in anomalous concentrations. The site's subsurface and hydrogeologic conditions have not been investigated.

The risks associated with this site include:

- The strong exothermic characteristics of the waste when exposed to the atmosphere (i.e., the potential for fires and the possibility of violent chemical reactions).
- The potential for phosphine (toxic gas) generation.
- The potential for heavy metal migration (although considered minor).

This site poses some unique problems to implementing a closure plan. The proposed scenario reflects the characteristics of the site and the degree of security afforded by its location in a large U.S. Government installation.

3.5.26.1 Assumptions

The closure plan is based on the assumption that the violent reactions that could result from exposure of white phosphorus to oxygen represent the major threat posed by this site.

3.5.26.2 Closure Considerations

Closure of this site will involve the following actions:

1. Channelize the small stream to prevent future erosion into areas potentially containing white phosphorus.

2. Rough-grade the area by placement and compaction of fill. No excavation will be permitted during site grading operations.

3. Place an impervious cover comprised of natural silty clay over the area; cover all disturbed areas with topsoil and revegetate.

4. Set monument(s) and prepare a plot plan to delineate the closed site. Fence the entire area and post warning signs.

This closure plan should minimize risks to personnel during closure operations, and phosphine gas should not accumulate around the site due to wind dispersal.

The features of the closed site are shown on Sheet 5, and closure cost estimates are shown in Table 3-28. An implementation schedule is presented in Figure 3-25.

3.5.26.3 Post-Closure Care

Since hazardous material will remain after closure, a post-closure plan and ground water monitoring will be required. The site should be inspected quarterly during the first 3 years after closure, and biannually thereafter. Maintenance should be scheduled in response to observed damage to the final cover. A site inspection form is presented in Table 4-1.

In view of the nature of the wastes remaining at the site, particular attention should be given to the condition of the vegetation, particularly during the traditionally dry seasons. Distressed vegetation could indicate that exothermic reactions are occurring at depth. During the post-closure period, it is recommended that a firebreak be maintained about the perimeter fence. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $7,000 (1984 dollars).

3.5.26.4 Additional Investigations

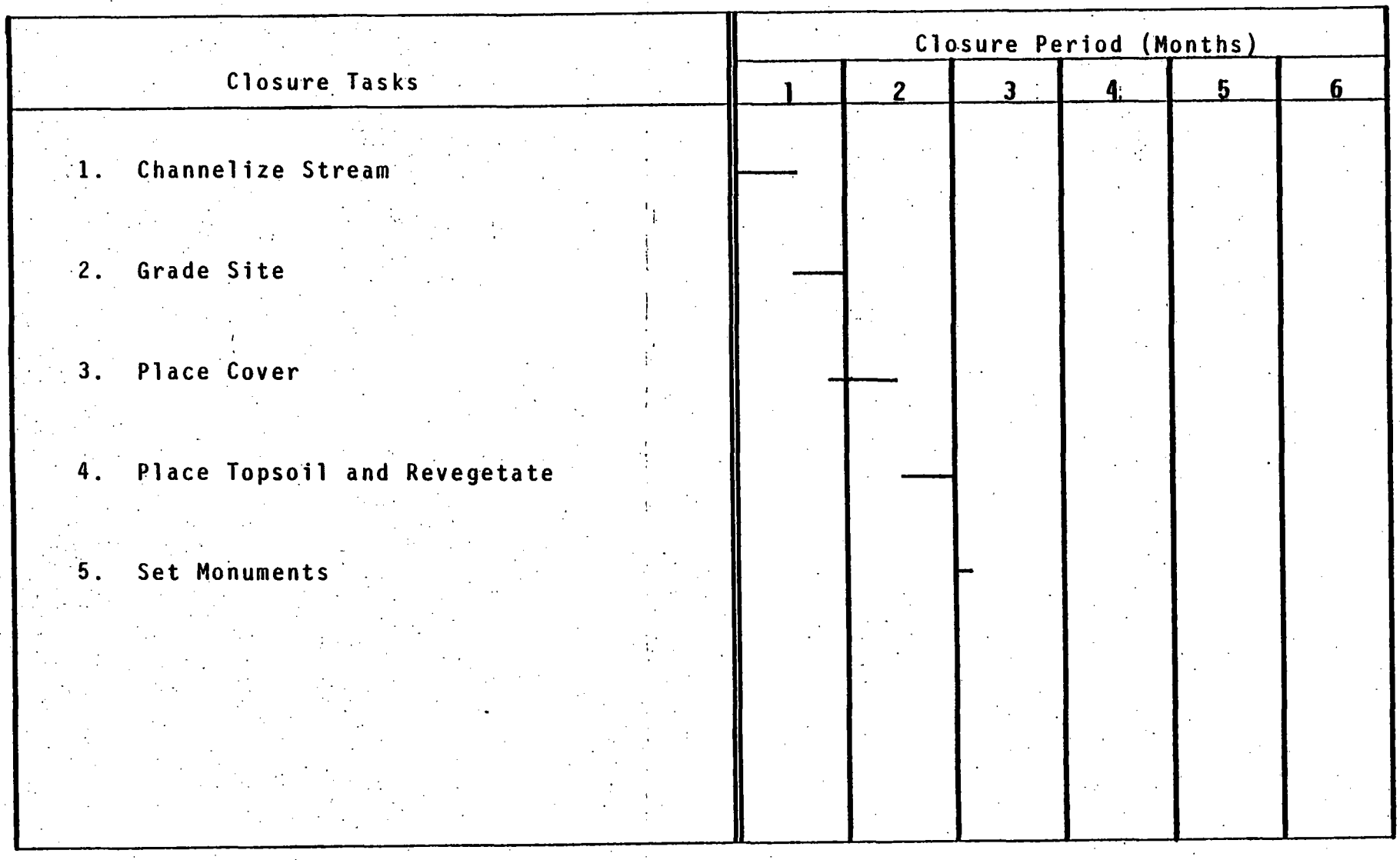
None.

TABLE 3-28. SITE 16A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	4,050 m^2	0.34/m^2	1,380
Excavation	90 m^3	3.13/m^3	280
Ordinary Fill	760 m^3	3.75/m^3	2,850
Low-Permeability Fill	1,300 m^3	3.75/m^3	4,875
Swale/Channel	70 m	4.38/m	310
Fencing	180 m	50.00/m	9,000
Revegetation	4,050 m^2	1.56/m^2	6,320
Topsoil	650 m^3	3.75/m^3	2,440
Subtotal			27,455
Engineering/Permit Fee (15% of Subtotal)			4,120
Contingencies (20% of Subtotal)			5,490
Total (1982 dollars)			37,065
Total (1983 dollars)*			40,770
Total (1984 dollars)*			44,850

* Calculated at an inflation rate of 10 percent per year.

Figure 3-25. Site 16a, proposed closure implementation schedule.



3.5.27 Site 20b, White Phosphorus Slag Burning and Disposal Area

Site 20b is a relatively small area formerly used as a white phosphorus slag burning and disposal area. The site is littered with rusted 50-gallon drums, wooden pallets, and other debris. The site is located adjacent to Site 20a, but at a higher elevation. The soil stratigraphy in this area should be similar to that of Site 20a (see Appendix B). Soil sample analyses indicate significant lead concentrations in the area. This site will require a closure/post-closure plan.

3.5.27.1 Assumptions

It is assumed that the contaminated soil remaining at the site is a hazardous waste.

3.5.27.2 Closure Considerations

Closure of this site will involve the following actions:

1. Remove all surface debris, and dispose of nonhazardous material in an approved sanitary landfill. Any hazardous materials should be disposed of in PBA's incinerator or in a secure landfill.

2. Take measures to eliminate surface water percolation through contaminated areas into the ground water. Construct diversion trenches with impermeable liners to divert rainfall runoff from entering the area.

3. Place an impervious 24-inch silty clay cover over the entire area, and grade the site to promote runoff.

4. Place topsoil on the site and revegetate the area.

5. Set monument(s) to delineate the boundaries of the closed site.

The features of the closed site are shown on Sheet 21. The cost estimate for closure is presented in Table 3-29. An implementation schedule for the closure plan is presented in Figure 3-26.

3.5.27.3 Post-Closure Care

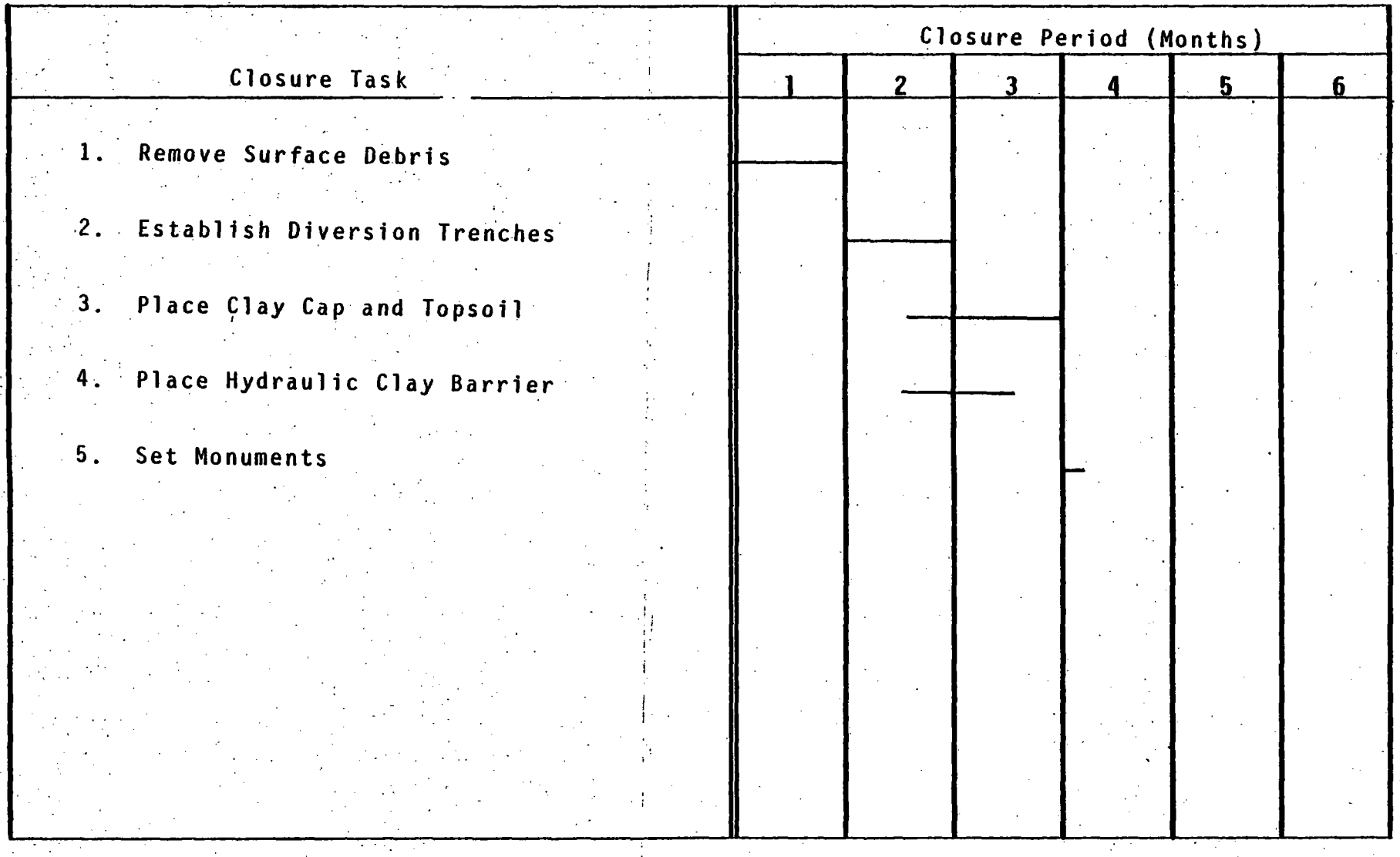
Post-closure care and ground water monitoring will be required. Major post-closure care requirements will include periodic inspection of the final cover and the diversion trenches for erosion problems. Semiannual inspections for the first 3 years, and annual inspections thereafter, should be sufficient. Such problems as damage to the clay cap or water standing in depressed areas should be repaired as necessary. The estimated annual post-closure care (maintenance) cost for this site, exclusive of

TABLE 3-29. SITE 20B COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Low-Permeability Fill	10,510 m^3	3.75/m^3	39,415
Swale/Channel	1,220 m^3	4.38/m^3	5,345
Topsoil	4,960 m^3	3.75/m^3	18,600
Revegetation	16,260 m^2	1.56/m^2	25,365
Subtotal			88,725
Engineering/Permit Fee (15% of Subtotal)			13,310
Contingencies (20% of Subtotal)			17,745
Total (1982 dollars)			119,780
Total (1983 dollars)*			131,760
Total (1984 dollars)*			144,935

* Calculated at an inflation rate of 10 percent per year.

Figure 3-26. Site 20b, proposed closure implementation schedule.



monitoring and inspection efforts, is approximately $1,500 (1984 dollars).

3.5.27.4 Additional Investigations

Prior to final design of the closure plan for this site, the assumption that the contaminated soil is a hazardous waste should be confirmed. If this material is not hazardous, the closure plan should be reevaluated.

3.5.28 Site 29, Solid Waste Arkla Site

Site 29, also referred to as the Arkla site, consists of approximately 40 acres of partially cleared land which formerly contained a chlorine production facility. The buildings, tanks, and other production equipment have been removed. Approximately one-half of the site is covered with small scrub pines. The remainder of the site is cleared, with little or no vegetation covering the areas where structures have been razed. Soil sample analyses indicate anomalous levels of arsenic, lead, and mercury. This site requires a closure/post-closure plan.

3.5.28.1 Assumptions

The recommended closure plan is based on two assumptions:

- Disturbance of an area this size would result in significant environmental impairment.
- The potential for heavy metal migration is related primarily to erosion.

3.5.28.2 Closure Considerations

Because of its extensive acreage and widespread contamination, closure of this site does not lend itself to an economical standard approach. The following steps should be taken to close the site in the most cost-effective fashion:

1. Establish diversion trenches to divert runoff.
2. Develop trenches as drainage swales (similar to diversion trenches) across the site to expedite runoff and reduce erosion. These swales will dump into a storm water reservoir.
3. Construct a storm water reservoir to retain runoff.
4. Place topsoil over all barren areas and revegetate the site.
5. Develop a ground water monitoring plan.
6. Set monument(s) and prepare a plot plan to delineate the location of the closed site.

The reservoir will be monitored periodically, and the wastewater transported to the PBA treatment facility or discharged directly, according to its characteristics. Retention basin monitoring parameters will need to be developed along with the ground water monitoring plan. Development of such a monitoring plan is beyond the scope of this study.

The features of the closed site are shown on Sheet 22. A cost estimate for implementation of the closure plan is presented in Table 3-30. An implementation schedule is shown in Figure 3-27.

3.5.28.3 Post-Closure Care

The site will require post-closure care and ground water monitoring. The site will require close monitoring to determine the fate of storm water collected on the site. In addition, normal levels of maintenance are anticipated. The estimated annual post-closure care (maintenance) costs for this site, exclusive of monitoring and inspection efforts, is approximately $3,000 (1984 dollars).

3.5.28.4 Additional Investigations

None.

3.5.29 Site 29a, Salt Pile

Site 29a consists of a salt pile associated with a former chlorine production plant. The pile has a volume of approximately 100 cubic yards, and has been spray-covered with asphalt. Analysis of the pile revealed low concentrations of cadmium, chromium, lead, and silver. Under RCRA regulations, the waste pile is not considered hazardous. State hazardous waste regulations will require disposal of the waste in a hazardous waste landfill.

3.5.29.1 Assumptions

It is assumed that this site is unsuitable for in situ closure due to the soluble nature of the rock salt and the presence of large volumes of highly contaminated soil.

3.5.29.2 Closure Considerations

Closure of this site will involve the following actions:

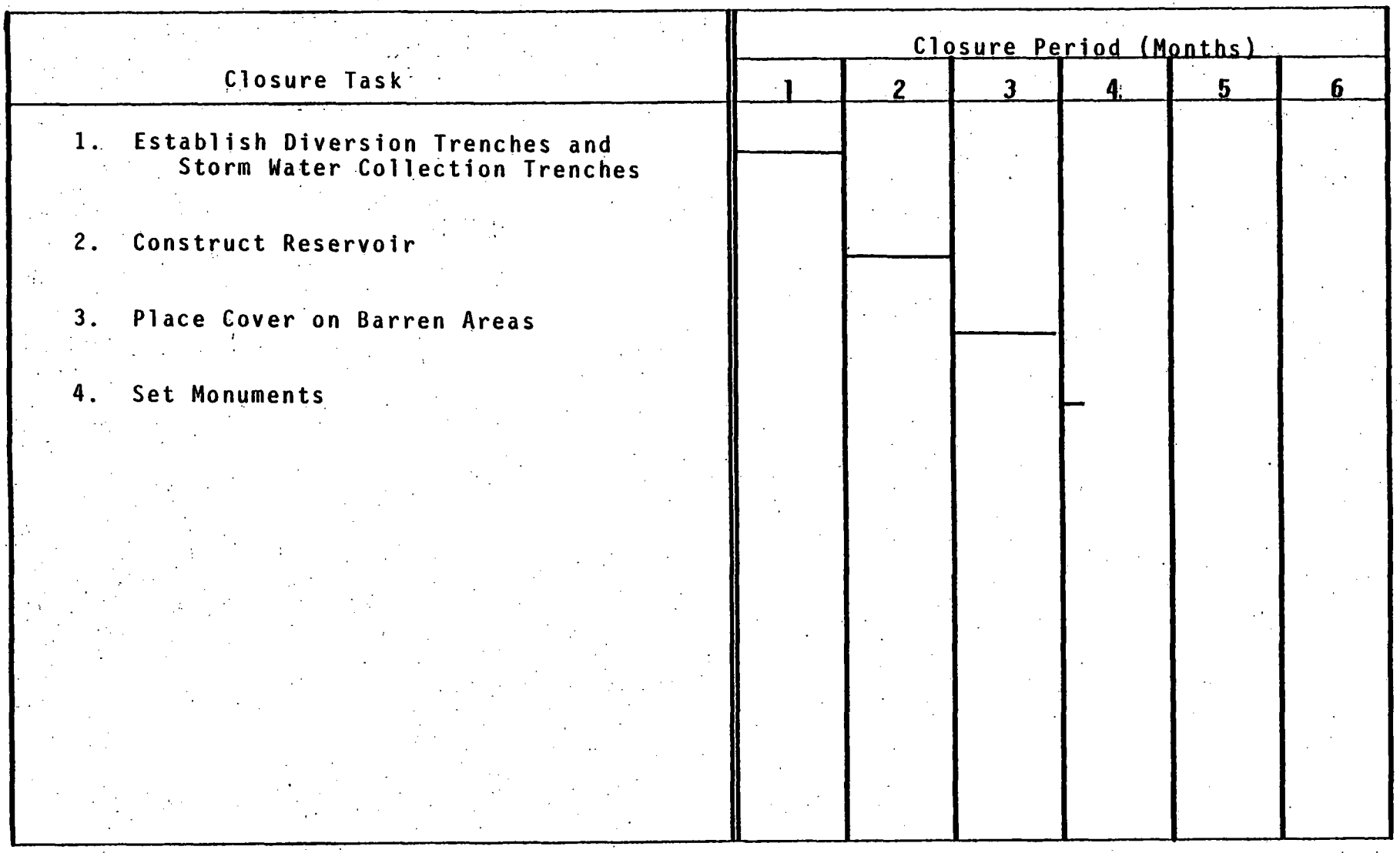
1. Remove all waste material to a hazardous waste landfill.
2. Analyze all soil within 25 feet of the perimeter of the pile, and remove any contaminated soil.
3. Grade the area to match existing contours, and revegetate the site.

TABLE 3-30. SITE 29 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation of Contaminated Material	5,150 m^3	3.25/m^3	16,740
Swale/Channel	7,750 m	3.50/m	27,125
Sand	940 m^3	8.50/m^3	7,990
Gravel	625 m^3	8.00/m^3	5,000
Clay Liner, On-Site	1,250 m^3	5.00/m^3	6,250
36-mil Reinforced Hypalon Sheeting	2,000 m^2	5.95 m^2	11,900
Topsoil	4,250 m^3	3.00/m^3	12,750
Revegetation	9,890 m^2	1.25/m^2	12,365
Sample Analysis	20	200 ea	4,000
Leachate Sump and Piping	1	750 ea	750
Subtotal			104,870
Engineering/Permit Fee (15% of Subtotal)			15,730
Contingencies (20% of Subtotal)			20,975
Total (1982 dollars)			141,575
Total (1983 dollars)*			155,735
Total (1984 dollars)*			171,305

* Calculated at an inflation rate of 10 percent per year.

Figure 3-27. Site 29, proposed closure implementation schedule.



The features of the closed site are shown on Sheet 22. Cost estimates for removal of the salt pile are shown in Table 3-31. Once a suitable repository for this material is available, closure can be effected within a period of 1 month.

3.5.29.3 Post-Closure Care

Post-closure care and monitoring are not required, since no hazardous material will remain after closure.

3.5.29.4 Additional Investigations

None.

3.5.30 Site 31a, Product Assurance Test Range (Goat Shed)

The abandoned product assurance test range (goat shed) was previously used for testing smoke grenades. Only small quantities of waste material are found at the site. Minor heavy metal and DDT contamination was found at this site during previous investigations.

3.5.30.1 Assumptions

No hazardous materials will remain after closure.

3.5.30.2 Closure Considerations

Closure of this site will involve the following actions:

1. Remove surficial waste and sludge materials.
2. Install an impervious cover, sloped to promote runoff, over the entire contaminated area.
3. Install a perimeter ditch to intercept run-on.
4. Revegetate the site.
5. Set monument(s) to delineate the site's location.

Estimated costs for implementing this closure plan are presented in Table 3-32, and a proposed implementation schedule is shown in Figure 3-28. A grading plan for Site 31a is shown on Sheet 8.

3.5.30.3 Post-Closure Care

Since no hazardous waste will remain at the site and since soil contamination is minimal, ground water monitoring will not be required. During closure, periodic inspections of the facility and maintenance, as warranted, will be required. Inspections should be conducted annually for 3 years, and biannually thereafter. An inspection form is presented in Table 4-1.

TABLE 3-31. SITE 29A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Excavation of Contaminated Material	150 m^3	4.07/m^3	610
Revegetation	4,050 m^2	1.56/m^2	6,320
Topsoil	1,230 m^3	3.75/m^3	4,615
Subtotal			11,545
Engineering/Permit Fee (15% of Subtotal)			1,730
Contingencies (20% of Subtotal)			2,310
Total (1982 dollars)			15,585
Total (1983 dollars)*			17,145
Total (1984 dollars)*			18,860

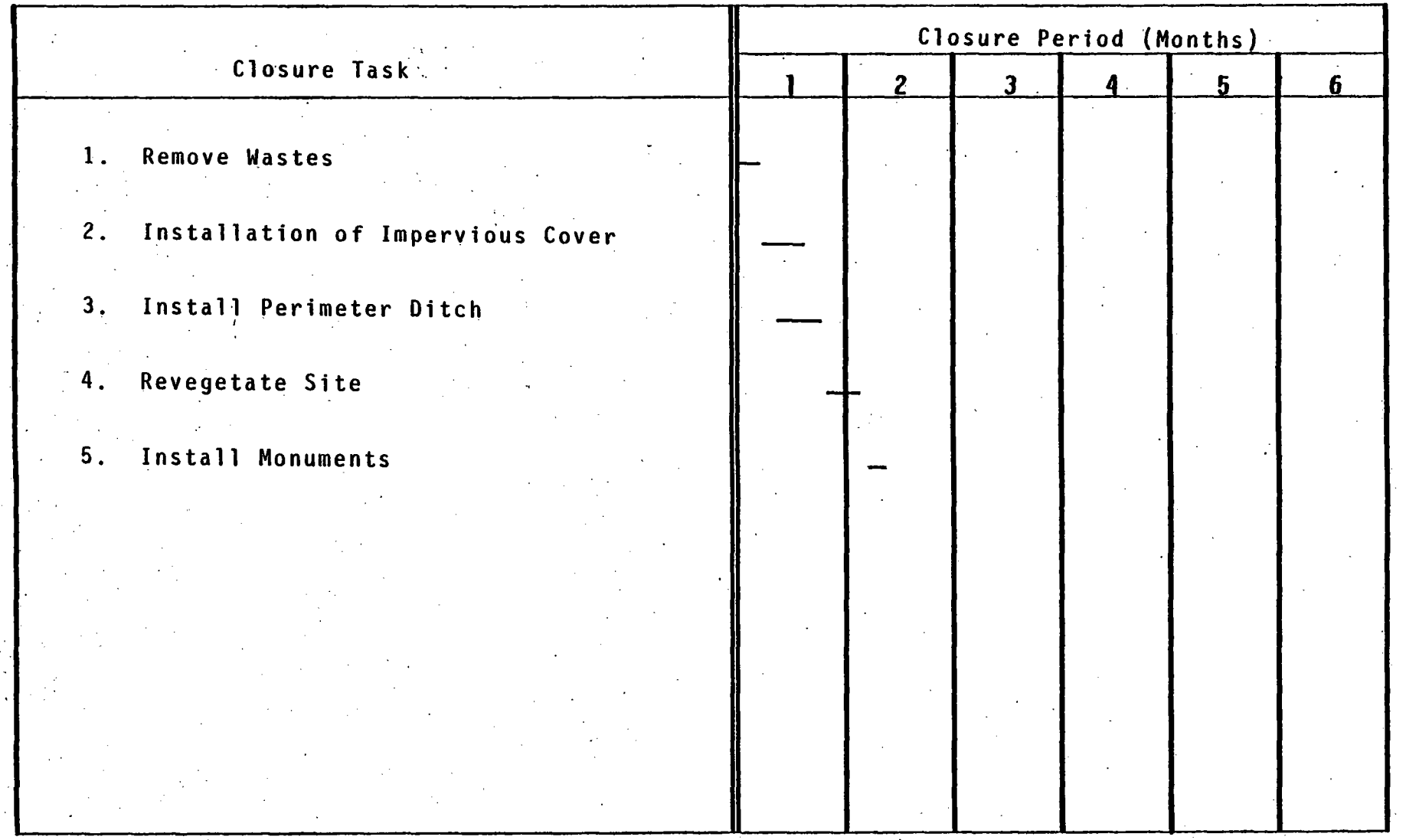
* Calculated at an inflation rate of 10 percent per year.

TABLE 3-32. SITE 31A COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Ordinary Fill	3,580 m^3	3.75/m^3	13,425
Low-Permeability Fill	5,660 m^3	3.75/m^3	21,225
Swale/Channel	450 m	4.38/m	1,970
Revegetation	9,100 m^2	1.56/m^2	14,195
Topsoil	2,830 m^3	3.75/m^3	10,615
Subtotal			61,430
Engineering/Permit Fee (15% of Subtotal)			9,215
Contingencies (20% of Subtotal)			12,285
Total (1982 dollars)			82,930
Total (1983 dollars)*			91,225
Total (1984 dollars)*			100,345

* Calculated at an inflation rate of 10 percent per year.

Figure 3-28. Site 31a, proposed closure implementation schedule.



3.5.30.4 Additional Investigations

None.

3.5.31 Site 34, NCTR Equalization Pond

The NCTR equalization pond is located at the northern end of PBA. This 1.5-acre lagoon contains some fluid (probably the result of rainfall) and an unknown quantity of sludge. Use of this facility was discontinued in June 1980. Analysis of the fluid and sludge indicate that these materials are not hazardous. A generalized description of the site's geologic conditions is given in Appendix B.

3.5.31.1 Assumptions

None.

3.5.31.2 Closure Considerations

Closure of the NCTR equalization pond will involve the following actions:

1. Demolish (or salvage) and remove the ancillary structures (pump house and piping).

2. Plug the influent and effluent pipes with cement grout.

3. Remove the standing fluids to PBA's water treatment plant.

4. Regrade the site either by pushing the earthen dikes inward to cover the sludge, or by breaching the lowermost dike, regrading the lagoon bottom to prevent ponding, followed by placement and compaction of a minimum of cover.

5. Revegetate disturbed areas of the site.

Estimated costs for implementing the proposed closure plan are presented in Table 3-33, and an implementation schedule is given in Figure 3-29. The major elements of site closure are shown on Sheet 12.

3.5.31.3 Post-Closure Care

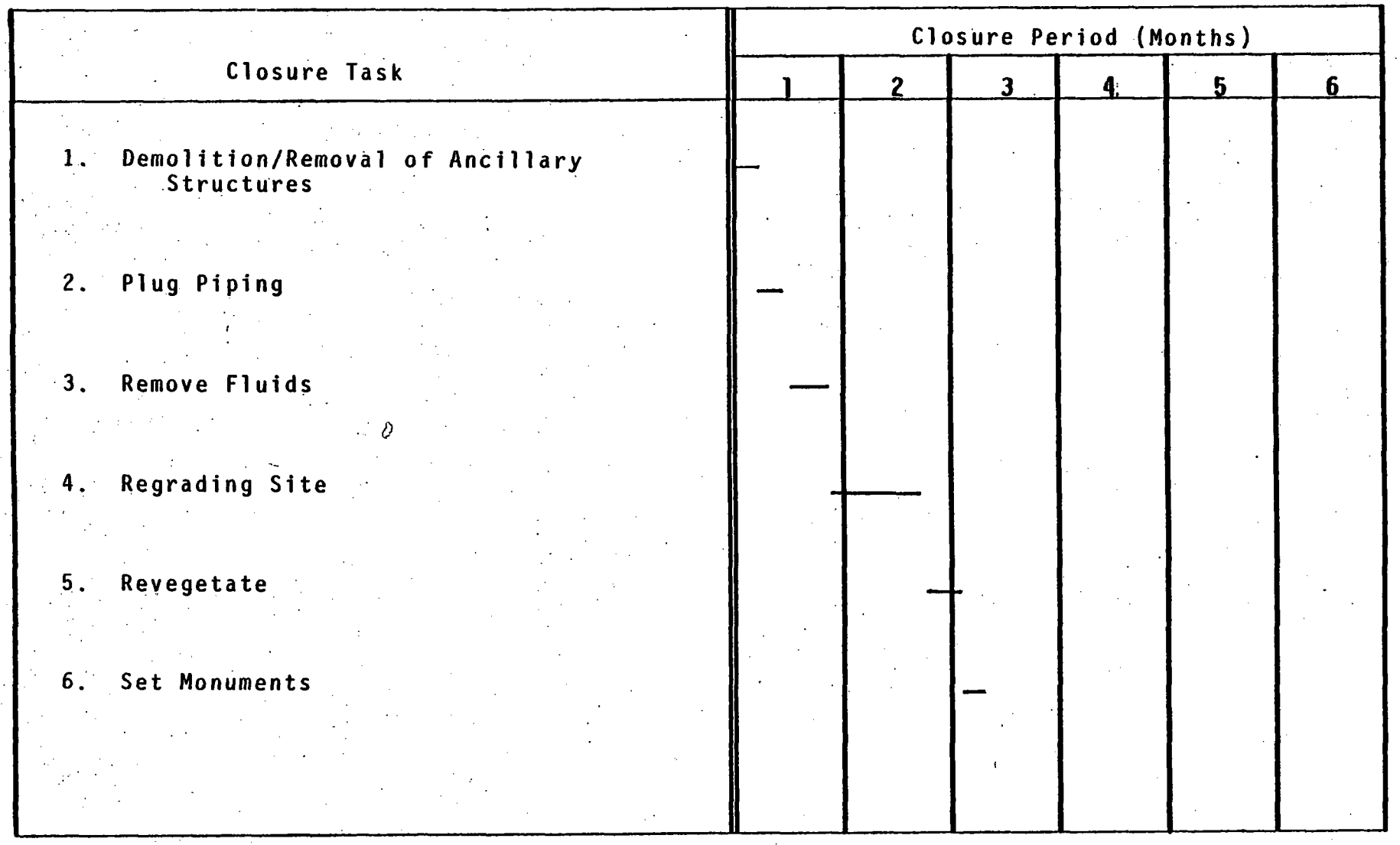
Post-closure care requirements will be minimal, since no hazardous material will remain at the site. Inspection should be conducted annually for 3 years, and maintenance of the drainage and cover provided as warranted. An inspection form is presented in Table 4-1.

TABLE 3-33. SITE 34 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Clearing/Grubbing	2,020 m^2	0.34/m^2	685
Earth Movement/Grading of Contaminated Material	1,090 m^3	4.09/m^3	4,435
Ordinary Fill	3,170 m^3	3.75/m^3	11,890
Revegetation	6,070 m^2	1.56/m^2	9,470
Topsoil	1,830 m^3	3.75/m^3	6,860
Subtotal			33,340
Engineering/Permit Fee (15% of Subtotal)			5,000
Contingencies (20% of Subtotal)			6,670
Total (1982 dollars)			45,010
Total (1983 dollars)*			49,510
Total (1984 dollars)*			54,460

* Calculated at an inflation rate of 10 percent per year.

Figure 3-29. Site 34, proposed closure implementation schedule.



3.5.31.4 Additional Investigations

It is not anticipated that additional investigations of the NCTR equalization pond will be necessary to permit final design and implementation of the recommended closure plan.

3.5.31.5 Alternative Site Use

The NCTR equalization pond could potentially be used as a repository for waste materials and/or contaminated soils from other sites. A number of the 31 sites addressed in this report are unsuitable for in situ closure or small enough, so that removal of their wastes/contaminated soils is more feasible than in situ closure. From an environmental standpoint, it is advantageous to minimize the number of sites containing hazardous wastes after closure. Presently, there is no suitable facility available for deposit of these waste materials and contaminated soils.

It is possible that Site 34 could be adapted to serve such a purpose by improving the pond liner and installing a ground water monitoring system. The proposed closure plan would need substantial revisions, and additional post-closure care would be required. If such action is deemed appropriate, a subsurface investigation should be completed to delineate the site's hydrogeologic conditions. In the event that such action is deemed feasible, the lagoon liner and the site's final cover should be upgraded to meet Arkansas standards for hazardous waste landfills.

3.5.32 Site 38, Impregnite Sludge Lagoon

The impregnite sludge lagoon contains impregnite mix and chloroethylene solvent stripper. This impoundment is approximately 30 feet square, 15 feet deep, and unlined. The sludge is not hazardous. At the time of our site visit, the surface of the sludge was relatively firm and exhibited dessication cracks in spite of recent rains. The condition of the sludge at depth is unknown. The lagoon is suspected to contain approximately 300 cubic yards of sludge. The site's subsurface and ground water conditions have not been investigated. However, based on information from the surrounding area, a generalized geologic description has been prepared, and is presented in Appendix B.

3.5.32.1 Assumptions

The major assumption inherent in this closure plan is that the impregnite sludge has adequate strength to support the recommended cover materials.

3.5.32.2 Closure Considerations

Closure of this nonhazardous facility will involve the following actions:

1. Place and compact soil material, crowned to promote runoff, over the impoundment. The cover should be a minimum of 2 feet thick, and extend beyond the top of the existing dikes.

2. Cover the site with topsoil and revegetate.

The features of the closed site are shown on Sheet 12, and implementation costs are presented in Table 3-34. A closure schedule is presented in Figure 3-30.

3.5.32.3 Post-Closure Care

Since no hazardous material will remain after closure (the site is nonhazardous), ground water monitoring and a post-closure plan are not required by RCRA. However, it is recommended that the site be inspected periodically and maintenance provided as warranted to repair damage to the cover and/or revegetation. A site inspection form is presented in Table 4-1. Annual inspections for 3 years, and biannual inspections thereafter, should be adequate.

Although not required, it is recommended that a plot plan be prepared and recorded to provide a permanent record of the site's location. Its presence would impact future use of the land.

3.5.32.4 Additional Investigations

The actual depth and strength characteristics of the sludge should be determined to permit assessment of its capacity to support the cover material. If the sludge is unstable, it may need to be mixed with soil or stabilized by some other method.

TABLE 3-34. SITE 38 COST ESTIMATE FOR THE IMPLEMENTATION OF PROPOSED CLOSURE PLAN

Item	Quantity	Unit Cost ($)	Total Cost ($)
Ordinary Fill	80 m^3	3.75/m^3	300
Revegetation	150 m^2	1.56/m^2	235
Topsoil	50 m^3	3.75/m^3	190
Subtotal			725
Engineering/Permit Fee (15% of Subtotal)			110
Contingencies (20% of Subtotal)			145
Total (1982 dollars)			980
Total (1983 dollars)*			1,080
Total (1984 dollars)*			1,190

* Calculated at an inflation rate of 10 percent per year.

Figure 3-30. Site 38, proposed closure implementation plan.

Closure Tasks	Closure Period (Months)					
	1	2	3	4	5	6
1. Place Cover	—					
2. Revegetate	—					

SECTION 4

PROCEDURES AND GENERAL CONSIDERATIONS

The closure scenarios presented in Section 3 often refer to a number of construction procedures, materials, and activities associated with the conceptual closure and post-closure plans. This section provides criteria for implementation of these plans and/or elaborates upon the above-mentioned reference items. This section is thus a necessary supplement to each of the conceptual closure and post-closure plans previously presented.

4.1 INSPECTION AND CERTIFICATION OF SITE CLOSURE

RCRA mandates that completion of site closure be certified by both the owner/operator of the site and an independent registered professional engineer. However, the COE has taken the position that the District Engineer will sign the certification in place of an independent registered professional engineer. The basis of the owner/operator's certification is further discussed in Section 4.6, Construction Control and Quality Assurance.

The District Engineer's certification is intended to assure the EPA Regional Administrator that the site has been closed in accordance with the approved closure plan. This certification is not intended to guarantee the adequacy of the closure plan. It need not be based on continuous inspection of closure operations or on elaborate testing and analysis. Rather, it should be based on periodic inspections and other efforts, as deemed necessary by the professional providing the certification.

There is no required format for certification, and considering the diversity of the sites and closure procedures required for PBA, the inspection/testing protocol and format requirements should be established on a site-specific basis.

4.2 MONUMENT PLACEMENT AND PLOT PLAN

Hazardous waste facilities which are closed in situ will need to be permanently located, and any restrictions regarding their future use documented in the deed to the property and/or the land use plan where they are located. Such restrictions should address the nature of the wastes and environmental control features constructed during closure, and should be designed to prevent release or migration of the contained wastes during future site use.

Each site's location should be established relative to a permanent monument or monuments, as determined by a licensed professional surveyor. The surveyor will then prepare a plot plan and legal description of the closed site, and record such with the Registrar of Deeds. The owner should incorporate any restrictions regarding future use of the closed site (resulting from the nature of the wastes that it contains) into the deed to the property.

SCS recommends that the permanent monument(s) installed at each site be constructed of steel-reinforced concrete or be cut from a durable rock material such as granite. The monuments should be a minimum of 4 feet long and 6 inches square in cross section, and buried so as to protrude no more than 6 inches above the ground. They should be engraved or provided with a durable, noncorrosive, permanently affixed plaque. The plaque will document the presence, dimensions, and nature of the facility, as well as the position of the monument relative to the closed facility.

Irregularly shaped sites should be provided with an additional demarcation in the form of an iron rod or pipe driven into the ground analogous to property cornerpins. The location of all monuments and pins should be shown on the plot plan. Further, the location of the monument(s) should be established in terms of latitude and longitude or some other widely used grid system to permit ready identification of their location in the future.

4.3 POST-CLOSURE INSPECTION AND CARE

All sites in which wastes remain after closure must be provided with post-closure care and maintenance. Thus, each of the closure plans presented herein includes, as a portion of the required post-closure plan, a description of the general types of maintenance anticipated to be necessary to properly maintain the recommended environmental control systems. The other portion of the required plan is the monitoring plan. All hazardous waste sites which are closed in situ will require a monitoring plan. It is understood that such plans are in the process of being finalized by the COE, Fort Worth District, and will be appended hereto.

There are two aspects of post-closure maintenance: site inspection, and correction of deficiencies noted during the inspections. The individual who inspects each site should utilize a standardized format to record his observations. He should carefully survey the site to determine its general condition, and pay particular attention to those environmental control features specific to the site. Key elements include the integrity of the final cover, the condition of run-on/runoff control features, and the condition of the site's vegetation. Standardized reports should be prepared during each inspection, and become part of the permanent post-closure monitoring files.

Three alternative recommendations can result from inspection of a closed site. These are:

- No action and continuance of the normal inspection schedule.
- Acceleration of the inspection schedule to provide more frequent observation of suspected or potential problems.
- Action to correct a deficiency.

If action is required, it should be implemented with the same care in design and construction control as is used in site closure. Such action should be summarized in a formal report which will then be placed in the site's file.

The most common types of maintenance anticipated will include patching the cover (cap), revegetation, repair of storm damage and erosion, and removal of sediment from ditches and other hydraulic control structures. A site inspection form covering routine items which need to be addressed during each inspection is presented in Table 4-1. It is expected that the inspector will provide photographs, sketches, and other attachments, as warranted, to clarify his remarks. Additionally, the inspector should review the site's file, particularly with regard to the previous inspection report(s), the ground water monitoring data (both water level and chemical analyses), and reports of any maintenance performed subsequent to the previous inspection.

4.4 SUBSURFACE EXPLORATION AND INSTRUMENTATION

Several of the conceptual closure plans presented herein are subject to reconsideration pending completion of additional subsurface investigations. These investigations are intended to more fully delineate the characteristics of the site's subsurface environment, and to permit detailed evaluation of subsurface contaminant pathways. Such investigations will thus confirm the viability of the proposed closure plans. They will need to be conducted by qualified geotechnical professionals prior to final design of closure actions.

Considering the limitations of the generalized types of subsurface information presently available, it is likely that the investigations for many of the sites will need to be conducted in at least two phases. Subsurface investigations are accomplished by means of borings, test pits, geophysical methods, and soils laboratory investigations. In view of the apparent complexity of the sursurface at PBA (as revealed by the generalized investigations conducted to date), strong emphasis should be placed on a direct means of investigation (e.g., borings and test pits). Further, it is likely that numerous explorations will be required to permit suitable assessment of a site's subsurface. For several sites, it will be necessary to determine the stratigraphy, ground water flow patterns (both horizontal and vertical), ground water table fluctuations, and seasonal high ground water table.

TABLE 4-1. POST-CLOSURE SITE INSPECTION FORM (SUGGESTED FORMAT)

Site _____ Date _____ Inspector _____

Feature	Item	Previous Status[1] OK	1[2]	2[3]	3[4]	Current Status OK	1[1]	2[2]	3[3]	See Attachment No.	Comment
Cover	Cracking										
	Puncture										
	Erosion										
	Settlement										
	Vehicle tracks										
	Ponding										
Vegetation	Density										
	Appearance										
Surface Water Controls	Erosion										
	Sedimentation										
	Ponding										
	Structural integrity										
Sediment Control	Sediment accumulation										
	Structural integrity										

Notes: 1 - Shows results of previous inspection for comparison.
2 - Indicates a potential problem and a need to monitor the situation carefully.
3 - Indicates a need for future maintenance.
4 - Indicates a need for immediate action.
5 - Attach sketches and/or photos and descriptions of any current status item other than "OK".

TABLE 4-1 (continued)

Ground Water Monitoring:

- Number of wells _____; Date of last round of monitoring _____.
- Were significant variations in water quality detected? Yes[1] ___ No ___
- Were significant variations in water level observed? Yes[1] ___ No ___
- Is monitoring scheduled concurrently with this inspection? Yes[2] ___ No ___
- Are exposed portions of monitoring wells disturbed or damaged? Yes[1] ___ No ___

Subsurface Environmental Controls:

- Are any subsurface environmental control features inherent in the site closure plan? Yes ___ No ___
  If yes, attach site-specific inspection form and perform required inspections.

Comments:

Inspector _____ Approved _____

Attachments:

1. Descriptions/sketch maps/photographs of any current status items not designated "OK".
2. Current ground water field monitoring reports.
3. Summary of previous ground water monitoring reports of anomalous results detected.
4. Site-specific subterranean control feature report(s).

Notes: 1 - If yes, prepare description and attach.
2 - If yes, attach field report for each well.

The hydrogeologic data presently available suggest that shallow ground water flow at PBA is controlled by near horizontal to slightly dipping sandy zones separated by clayey layers. It appears that perched water tables are common, although in some instances, they may be a seasonal phenomenon. It will be important to determine the degree of interconnection between the water-bearing zones and their relative piezometric levels. This can only be accomplished by means of piezometer or observation well clusters to permit direct measurement of potentiometric levels at a given location. It should be noted that these instruments, if suitably designed and constructed, can serve as supplementary monitoring wells during post-closure monitoring.

Once a site's stratigraphy, the physical characteristics of its subsurface materials, and its ground water flow patterns have been sufficiently defined, it will be possible to assess the actual suitability of the conceptual closure plan proposed herein. The key question to be resolved is whether or not the proposed conceptual closure plan will effectively eliminate and/or seal off the existing surface and subsurface contaminant pathways. If the additional data indicate that this will not be the case, the conceptual closure plan must be modified.

Data gathered from the recommended subsurface investigations will provide the information needed to develop final design drawings and specifications for construction purposes. The types of features that require specific consideration during final design include:

- Subterranean structure design (i.e., drains, cutoff walls, and excavations).
- Material specifications and sources.
- Borrow placement and compaction requirements.

Any additional investigations which are required to define the depth or extent of contamination at any of the 31 sites should be coordinated with the geotechnical investigations to avoid duplication of effort.

4.5 BORROW CONSIDERATIONS

During implementation of the closure plans, substantial volumes of borrow will be required. Materials that will be needed in the greatest quantity are:

- Common borrow - natural earth material free of organics, large stones, and debris (for grading, embankment construction, and backfill). During final design, additional properties may be required for specific sites.

- Impervious material - natural clayey soil free of organics, large stones, and other debris (to be used in cover, liner, and for dike/berm construction) that, when placed and compacted, will possess a permeability of 10^{-7} cm/sec or less.

- Topsoil - natural earth material suitable for spreading in thin lifts and for supporting vegetation.

Other soil or aggregate materials which will be required in lesser quantities include granular materials of various dimensions for use as drains, bedding, and erosion protection.

Available subsurface information for PBA indicates that it should be possible to obtain common borrow, impervious material, and topsoil on site[4] (see Appendix B). It will be necessary to conduct a borrow investigation to delineate areas where suitable materials can be obtained, and to determine their characteristics so that proper placement and compaction criteria can be established. The on-site availability of granular soils for construction cannot be evaluated on the basis of the available data.

4.6 CONSTRUCTION CONTROL AND QUALITY ASSURANCE

Earthwork and other construction carried out during site closure should be monitored by experienced inspectors to assure compliance with the plans and specifications. If anomalous or unanticipated conditions are encountered, these should be evaluated, and the closure design modified as appropriate.

A rigorous construction control and formal testing program should be implemented to provide quality control and documentation of compliance with specifications. Proper construction of the environmental control features which isolate contaminants from the environment is a critical factor that determines the effectiveness of the closure plan.

4.7 SAFETY

It is necessary to develop and implement a safety program to ensure that personnel working in the field during closure and post-closure operations will not be subjected to unacceptable health and/or safety hazards. This program must also address the issue of accident prevention during all field activities.

4.7.1 Safety Program

In addition to addressing the nature of materials known to be present at the subject sites, the safety program should contain detailed descriptions of the following:

- Safety organization.
- Safety administration.
- Safety training.

- Hazard analysis.
- Safe operating procedures.
- Safety equipment.
- Safety inspection procedures.
- Safety standards and codes.
- Shipping procedures.
- Waste disposal procedures.
- Emergency procedures.
- Accident investigation.
- Special safe operating procedures.
- Physical safety.
- Personnel decontamination.
- Radiation assessment.
- Snake bite response.
- On-site water supplies.
- On-site fire response.

Some of the above topics are covered in the contingency plan (e.g., local hospitals and paramedic units, fire stations, etc.). Others are also available from PBA.

Personnel should be fully trained and briefed for all potential hazards. Reference material, such as the U.S. Coast Guard Chemical Hazards Response Information System (CHRIS), should be utilized when unexpected hazardous conditions are encountered. Depending upon the complexity of the material to be handled, one or more training missions should be conducted by experienced personnel to demonstrate safety requirements, proper handling of waste material, and recordkeeping procedures.

4.7.2 Safety Measures

Generally, the amount of safety measures to be used at PBA will depend upon the degree of hazards present or associated with site closure activities. It is important for the site engineer to determine which safety measures should be employed at a specific hazardous waste site. However, the following activities are forbidden during fieldwork at any site:

- Eating, drinking, or smoking.
- Igniting or creating a flame.
- Working with hazardous waste without proper protection to ensure safe handling.
- Working without a partner nearby.

Because of the cost and efficiency associated with the safety measures in conducting the fieldwork, the same measures are not recommended for use at all sites. Depending upon the potential for explosion, personnel injury, or adverse health effects that may result during working, the sites are tentatively grouped into three areas: (A) extremely hazardous; (B) hazardous; and (C) potentially hazardous.

Recommended measures for these areas are as follows:

- Follow all safety procedures that were given in training (A, B, C).
- Keep a daily record of time, date, and working area (A, B, C).
- Place barricades, as required, around the site where closure activities are in progress to prevent unauthorized persons and vehicles from entering (A).
- Notify the site engineer immediately when a spill of hazardous waste occurs from a leaking drum; leave the clean-up for trained personnel (A, B, C).
- Avoid skin or eye contact with hazardous waste or waste-contaminated material:

  - EYE PROTECTION: Wear chemical goggles, safety glasses with side shields, face shield with either chemical goggles or safety glasses, or full facepiece respirator (A, B).

  - HAND PROTECTION: Wear gloves made of material that is highly resistant to the waste material/solvents being handled (A, B, C).

  - PROTECTIVE CLOTHING & OVERSHOES: Wear clothing made out of material resistant to waste material. solvents being used (A). No protective clothing is completely resistant to all hazardous wastes. If possible, choose clothing which can be disposed of after use. Always remove protective clothing after it has come into contact with the waste.

- Avoid breathing vapors or airborne particles of waste emitting from the waste pile or during excavation (A, B). If there is the possibility of toxic vapor in the air, make sure that the area is well ventilated, or wear a respirator. Similarly, if contaminated dust is generated in the working area, wear a respirator. (OSHA safety standards require proper selection, fitting, and maintenance of respirators, and training of all workers who may have to wear a respirator either as part of their normal job or during an emergency.)
- Conduct work in a manner that minimizes potential exposure to hazardous wastes either to yourself or to other workers (A, B, C).

- Collect air samples periodically during excavation, and analyze for contaminants known to be present in the waste (A).

- Decontaminate surfaces (e.g., tools, equipment, etc.) exposed to hazardous waste or waste-contaminated material by washing down with appropriate solvent (A, B).

- Dispose of contaminated clothing, boots, gloves, spent solvent, etc., in containers provided specifically for disposal purposes (A, B).

- Wash hands after removing protective equipment and clothing (A, B, C).

- If eyes are contaminated with hazardous waste, flush them with water for at least 15 minutes, wash face with soap and water, and see a physician (A, B, C).

- If skin is contaminated with hazardous waste, remove any contaminated clothing, and wash the exposed skin immediately with water (A, B, C).

4.8 REVEGETATION CONSIDERATIONS

Revegetation is necessary to protect the exposed final cover soil against erosion and disruption, decrease wind and water erosion, aid soil stabilization and dust control, and improve the appearance of the disposal site. A revegetation program consists of four steps:

- Plant selection.
- Soil preparation and fertilization.
- Seeding and mulching, if necessary.
- Vegetative cover maintenance.

4.8.1. Plant Selection

Plants should be selected on the basis of their adaptability to local climate and soil fertility. Native species are most likely to be acclimated to the amount of rainfall and other seasonal conditions unique to the site. Particularly favorable plant characteristics include low growth spreading from rhizomes or stolons; rapid germination and development; and resistance to fire, insects, and diseases. Plants that are poisonous or likely to spread and become noxious should be avoided.

A large number of grasses and legume species are available for revegetation. Species with wide and frequent application are described in Tables 4-2 and 4-3. The varieties that are recommended by the Arkansas Department of Highway Transportation are given in Table 4-4. A local agronomist should be consulted for recommendation of locally adapted or newly introduced plant varieties.

TABLE 4-2. GRASSES COMMONLY USED FOR REVEGETATION

Variety	Best Seeding Time	Seed Density (seeds/ft^2)*	Important Characteristics	Areas/Conditions of Adaptation
Redtop bentgrass	Fall	14	Strong, rhizomatous roots, perennial	Wet, acid soils, warm season
Smooth bromegrass	Spring	2.9	Long-lived perennial, drought-resistant	Damp, cool summers
Field bromegrass	Spring	6.4	Annual, fibrous roots, winter rapid growth	Cornbelt eastward
Kentucky bluegrass	Fall	50	Alkaline soils, rapid grower, perennial	North, humid, U.S. south to Tennessee
Tall fescue	Fall	5.5	Slow to establish, long-lived perennial, good seeder	Widely adapted, damp soils
Meadow fescue	Fall	5.3	Smaller than tall, susceptible to leaf rust	Cool to warm regions, widely adapted
Orchard grass	Spring	12	More heat-tolerant but less cold-resistant than smooth bromegrass or Kentucky bluegrass	Temperate U.S.
Annual ryegrass	Fall	5.6	Not winter hardy, poor dry land grass	Moist southern U.S.
Timothy	Fall	30	Shallow roots, bunch grass	Northern U.S., cool, humid areas
Reed canarygrass	Late summer	13	Tall, coarse, sod-former, perennial, resists flooding and drought	Northern U.S., wet, cool areas

* Number of seeds per square foot when applied at 1 lb/acre.

Source: R. J. Lutton, G. L. Regan, and L. W. Jones. Design and Construction of Covers for Solid Waste Landfills. U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA 600/2-789-165, August 1979.

TABLE 4-3. LEGUMES COMMONLY USED FOR REVEGETATION

Variety	Best Seeding Time	Seed Density ($seeds/ft^2$)*	Important Characteristics	Areas/Conditions of Adaptation
Alfalfa (many varieties)	Late summer	5.2	Good on alkaline loam, requires good management	Widely adapted
Birdsfoot trefoil	Spring	9.6	Good on infertile soils, tolerant to acid soils	Moist, temperate U.S.
Sweet clover	Spring	6.0	Good pioneer on non-acid soils	Widely adapted
Red clover	Early spring	6.3	Not drought-resistant, tolerant to acid soils	Cool, moist areas
Alsike clover	Early spring	16	Similar to red clover	Cool, moist areas
Korean lespedeza	Early spring	5.2	Annual, widely adapted	Southern U.S.
Sericea lespedeza	Early spring	8.0	Perennial, tall, erect plant, widely adapted	Southern U.S.
Hairy vetch	Fall	0.5	Winter annual, survives below 0°, widely adapted	All of U.S.
Winter clover	Early fall	18	Worldwide, many varieties, does well on moist, acid soils	All of U.S.
Crownvetch	Early fall	2.7	Perennial, creeping stems and rhizomes, acid-tolerant	Northern U.S.

* Number of seeds per square foot when applied at 1 lb/acre.

Source: R. J. Lutton, G. L. Regan, and L. W. Jones. Design and Construction of Covers for Solid Waste Landfills. U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA 600/2-789-165, August 1979.

TABLE 4-4. COMMON GRASSES FOR REVEGETATION IN ARKANSAS*

Variety	Seeding Time	Seeding Rate (lb/acre)
Tall Fescue (Kentucky 31)	March 1 - April 15	35
Red Top (common)		5
Weeping Love Grass (Eragrostis Curvula)		5
Lespedeza (Korean)		30
		75
Weeping Love Grass (Eragrostis Curvula)	April 16 - June 30	5
Bermuda Seed (common), hulled		10
Lespedeza (Korean)		30
		45
Weeping Love Grass (Eragrostis Curvula)	July 1 - August 31	5
Bermuda Seed (common), hulled		5
Bermuda Seed (common), unhulled		10
Brown Top Millet		15
		35
Tall Fescue (Kentucky 31)	September 1 - October 15	35
Red Top (common)		5
Crimson Clover (Dixie)		20
		60

* Seeds should be composed of the individual varieties and seeding rates within each group shown above, as recommended by Arkansas Department of Highway Transportation.

4.8.2. Soil Preparation and Fertilization

The maximum slope on which vegetation can be established and maintained is 2:1 (horizontal:vertical), assuming ideal soil with low erodibility and adequate moisture-holding capacity. The use of landscape netting to facilitate revegetation on permanent 2:1 slopes may be desirable. Optimum vegetative stability generally requires slopes of 4:1 or less.

Since topsoil is generally more fertile than subsoil, it is advisable to stockpile and reuse the original topsoil as final cover to facilitate vegetative growth. The stockpile may have to be protected from erosion by covering with tarps or membranes, or storing in a covered building. This protection may not be necessary for the brief construction periods proposed for most sites at PBA. An operator may need to adjust the soil pH, depending on soil reaction and plant species selected. Most plant species prefer a pH in the range of 6.5 to 7.5.

The soils at PBA are acidic and fine- to medium-textured; liming appears to be beneficial to vegetative establishment. Agricultural limestone can be spread on the soil surface at a rate of 4 to 5 tons per acre, and mixed into the soil by rototilling.

Since the topsoil at PBA is probably low in plant nutrients (based on high rainfall and site history), the addition of fertilizers will be beneficial to vegetative growth. Fertilizers can be added during soil preparation by broadcasting and thoroughly mixing into the surface soil. The rate and frequency of fertilizer application and the specific nutrients added will depend on soil fertility and texture and the selected plant species.

Coarse-textured soils are normally low in fertility and organic matter content, and larger quantities of fertilizers (particularly nitrogen) will be needed. In these soils, several low-rate applications per year are preferred to a single heavy application, since nutrients will tend to leach out of the soil. In fine-textured soils with relatively high organic matter content and nutrient-holding capacity, it may be possible to apply less fertilizer in a single application. The Agricultural Extension Service generally provides soil testing and recommendations for nutrient requirements for various native plant species.

4.8.3 Seeding and Mulching

Seeding can be accomplished in a number of ways, including hand broadcasting, use of hand-operated seeders such as cyclone seeders, or larger mechanized seeding equipment. Hydroseeding, which permits application of seed, fertilizer, and mulch in a single operation, may be advisable at some sites. It is especially useful for initial seeding with quick-growing grasses. The seeding rate varies from 25 to 45 lb per acre, depending on the type of plant to be grown and its germinative ability.

Straw/hay mulch application is one of the most cost-effective methods of erosion control. In particular, where final cover includes coarse-textured topsoil, straw mulching is recommended to conserve the limited moisture during the growing season. Straw is applied at a rate of approximately 1.5 tons per acre, using a mulch spreader. The straw is incorporated into the soil by a straw crimper or other means. Often, a tacking material (e.g., netting, chemical stabilizers, etc.) is applied to reinforce the mulch.

4.8.4 Vegetative Cover Maintenance

Since post-closure care of the disposal site will continue for many years, permanent vegetative cover should be maintained. Once a vegetative cover is started and a stable, extensive root system develops, organic matter and decomposition processes develop a layer of humus capable of perpetuating the cover vegetation. However, erosion, burrowing animals, diseases, etc., may damage parts of the cover soil and vegetation. As such, provisions should be made for maintenance, specifically for transplanting grass sods, planting new seeds or shrubs, and replacing eroded soil during the post-closure care period.

SECTION 5

CONTINGENCY PLAN

5.1 INTRODUCTION

A contingency plan is required for PBA under 40 CFR 265.52, Hazardous Waste Management System, Federal Register, May 19, 1980. The purpose of the contingency plan is to describe the actions that facility personnel must take to minimize hazards to human health or the environment from fires, explosions, and any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, and surface water.

PBA already has a Spill Prevention Control and Countermeasures (SPCC) plan which details the installation's procedures for preventing, investigating, and responding to emergency situations. Also included in the SPCC plan is the PBA's Installation Spill Control Plan (ISCP) which defines responsibilities and procedures for reporting spills involving oils and hazardous material (Appendix C).

This section presents an addendum to the SPCC plan to include hazardous waste management provisions for PBA per RCRA requirements.

5.2 EMERGENCY RESPONSE

Information on the emergency coordinator and contacts is summarized in Table 5-1. In case of a disaster situation, including spills of oil and hazardous substances, assistance can be provided by the State of Arkansas Emergency Services Office. Continuous liaison is maintained with all federal and state agencies, including military installations/activities that have the capability to respond to disasters in the State of Arkansas.

In addition, PBA has an Installation Response Team consisting of selected employees from the Fire Protection and Prevention Department and the Directorate of Facilities Engineering. Team members have undergone a thorough training program covering containment and cleanup procedures and associated safety measures for oil and hazardous materials.

Available emergency equipment is listed in Table 5-2. The earth-moving equipment is maintained by the Directorate of Facilities Engineering, and is located near Building 32-035 or Building 51-570. Locations of other equipment and vehicles are not

logged. Fire extinguishers are maintained in every building and in every motor vehicle operated by PBA.

TABLE 5-1. LIST OF EMERGENCY COORDINATOR AND CONTACTS

On-Scene Coordinator	Alternative
Thomas Shook Office - (501) 541-3572 (b) (6)	Wendell Fortner Office - (501) 541-3578 (b) (6)

Fire Department at PBA

(501) 541-3507

Health Clinic at PBA

(501) 541-3409

Office of Emergency Services, State of Arkansas

(501) 374-1201
(501) 329-5601

Jefferson Regional Medical Center, Pine Bluff

(501) 541-7100

TABLE 5-2. EMERGENCY EQUIPMENT AND VEHICLES AVAILABLE TO PBA

Old Number	Item	New Number
HE-1	Crane	M&S 1
HE-2	Crane	M&S 2
HE-3	Crane	M&S 3
HE-7	Bulldozer, D-7	M&S 7
HE-8	Bulldozer, D-7	M&S 8
DDT-1	Bulldozer, D-7	M&S 9
DDT-2	Bulldozer, D-7	M&S 10
HE-11	Grader	M&S 11
DDT-4	Grader	M&S 12
DDT-8	Sheepsfoot roller	M&S 13
DDT-9	Dump truck	M&S 20
HE-21	Low-boy trailer	M&S 21
HE-23	Compressor	M&S 23
HE-24	Compressor	M&S 24
HE-25	Compressor	M&S 25
HE-26	Compressor	M&S 26
HE-27	Compressor	M&S 27
HE-36	Backhoes	M&S 36
HE-27	Backhoes	M&S 37
HE-38	Tractors, agriculture	M&S 38
HE-39	Tractors, agriculture	M&S 39
HE-46	Tractors, agriculture	M&S 46
HE-47	Tractors, agriculture	M&S 47
HE-48	Tractors, agriculture	M&S 48
HE-49	Tractors, agriculture	M&S 49
HE-55	Generator	M&S 55
HE-56	Generator	M&S 56
HE-57	Generator	M&S 57
HE-66	Lubricator, 2 250-gal tanks (1 gasoline, 1 diesel)	M&S 66
HE-71	Sand spreader (to be mounted on back of dump truck)	M&S 71
HE-73	Mud jack	M&S 73
HE-75	Fog gun	M&S 75
HE-76	Sprayer	M&S 76
HE-77	Magnet sweeper	M&S 77

TABLE 5-2 (continued)

Old Number	Item	New Number
HE-78	Core drill	M&S 78
HE-79	Leaf sweeper	M&S 79
HE-90	Welder machine	M&S 90
HE-91	Welder	M&S 91
HE-92	Welder	M&S 92
HE-93	Welder	M&S 93
HE-107	Mower, rotary	M&S 107
HE-113	Disk, 4-gang	M&S 113
CA-7386	Truck, firefighting	M&S 300
01L-48769	Truck, firefighting	M&S 301
04A32571	Truck, firefighting	M&S 302
WL-0281	Truck, firefighting	M&S 303
1M-2822	Truck, S&P	M&S 304
CB-4759	Truck, maintenance	M&S 305
CE-7878	Truck, van	M&S 306
CE-7879	Truck, van	M&S 307
CE-7880	Truck, van	M&S 308
CE-3882	Truck, van	M&S 309
CE-3882	Truck, van	M&S 310
CE-7883	Truck, van	M&S 311
HE-501	Clam bucket	M&S 501
HE-502	Clam bucket	M&S 502
HE-503	Clam bucket	M&S 503

SECTION 6

REFERENCES

1. U.S. Army Environmental Hygiene Agency. Hazardous Waste Special Study for Pine Bluff Arsenal, Pine Bluff, Arkansas. Army Pollution Abatement Program Study No. D-1620-S (AEHA Control No. 81-26-8219-81). Aberdeen Proving Ground, Maryland, June 1981.

2. International Research and Technology Corporation. Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities Under RCRA, Subtitle C, Section 3004. Closure and Post-Closure: Interim Status Standards (40 CFR 265, Subpart G). Report SW-912, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C., 1981.

3. Fortner, W. L., H. E. Owen, Jr., T. E. Shook, and W. D. McDonald. Installation Restoration (IR) Activities, 1970-1979. Technical Memorandum No. 14. Directorate for Engineering and Technology, Department of the Army, Pine Bluff Arsenal, Pine Bluff, Arkansas.

4. Broughton, J. S. Hydrogeological Survey of Pine Bluff Arsenal. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Missisippi, August 1980.

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APPENDIX A

WASTE COMPATIBILITY CHART

APPENDIX A

WASTE COMPATIBILITY CHART
(See Enclosed Envelope)

The waste compatibility chart was developed using published procedures.* The approach used in establishing the chart was conservative due to the lack of information regarding concentrations of materials and positive identification of some compounds.

The materials listed are those used in PBA operations. When two compounds compared on the chart are shown to be incompatible, one or more of the following consequences can be expected: heat generation, fire, innocuous and nonflammable gas generation, toxic gas generation, flammable gas generation, explosion, violent polymerization, or solubilization of toxic substances. This chart should be used to indicate a possible reaction between the compounds. Additional investigations should be conducted to verify their reactivity and consequences.

Further, it should be noted that some compounds not shown as reactive on the chart could react. Thus, it is recommended that, before mixing any two wastes in the secure landfill, further investigation of their reactivity be pursued.

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* Hatayama, H. D., et al. A Method for Determining the Compatibility of Hazardous Wastes. EPA 600/2-80-076, April 1980.

	Acetone, ketones	Agar - Agar	Alcohols	Aluminum, powder, or grained	Animal protein	Barium chromate	Barium nitrate	BZ	Calcium carbonate	Caustic	Cellulose nitrate-camphor	Cellulose nitrate	Charcoal	Chloracetophenone	Chlorates	Chlorine	Chromates	CS_2	Cysteine HCl	Dextrine	Dextrose	Diatomaceous earth	Dipyridyl	Dye, green	Dye, red	Dye, yellow	Fuller's earth	Glycene	Graphite	Hexachlorethane	Hydrochloric acid	Iron oxide	Lactose	Lard oil	Lead oxide (red lead)	Magnesium carbonate	Magnesium hydroxide	Magnesium powder	Metal powders	Nitrates (inorganic)	Nitrocellulose (wet)	Perchlorates	Phosphorus, red	Phosphorus, white	Plant protein	Potassium bicarbonate	Potassium chlorate	Potassium nitrate	Protamine sulphate	Quaternary ammonium compound (50% solution)	Raffinose	Resin	Silicone	Silicone antifoams	Skim milk solids	Soda, sodium bicarbonate	Sodium chloride	Sodium nitrate	Sodium sulfate	Sucrose	Sugar, powdered	Sulphur	Sulfuric acid	Thermit	Thiamine HCl	Thiourea	Titanium powdered	Tricalcium phosphate	Tryptose	Zinc borate	Zinc oxide
Acetone, ketones									●					●	●		●	●													●						●					●					●	●	●														●		●						
Agar - Agar			●	●						●					●	●			●				●					●			●						●	●	●	●		●	●	●			●	●	●	●													●	●	●		●			●	
Alcohols		●			●	●				●					●	●			●				●	●	●	●					●						●			●		●					●	●	●														●		●						
Aluminum, powder, or grained		●			●				●	●					●	●	●	●	●												●					●				●		●	●	●			●	●	●	●													●	●	●					●	
Animal protein			●	●		●	●	●		●				●	●	●	●		●				●	●	●	●		●			●						●	●	●	●		●	●	●			●	●	●	●													●	●	●		●			●	
Barium chromate			●		●					●					●								●					●								●				●		●	●	●	●		●	●	●	●						●								●						●	
Barium nitrate					●					●					●								●					●								●						●	●	●	●		●	●	●	●						●								●						●	
BZ					●										●	●			●												●						●			●		●					●	●	●														●	●	●						
Calcium carbonate				●							●	●			●		●		●																		●	●	●	●		●					●	●	●	●													●	●		●	●	●		●	
Caustic	●	●	●	●	●	●	●				●	●			●		●							●	●	●											●	●	●		●	●	●	●	●		●	●	●	●														●		●	●	●		●	
Cellulose nitrate-camphor									●	●					●	●			●												●					●	●					●					●	●	●														●		●						
Cellulose nitrate									●	●					●	●			●												●					●	●			●		●					●	●	●														●		●						
Charcoal															●	●			●												●						●			●		●	●	●			●	●	●														●	●	●					●	
Chloracetophenone					●										●	●	●		●												●				●		●			●		●			●		●	●	●														●		●						
Chlorates	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●					●	●	●	●		●	●	●				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●				●						●		●		●	●	●		●	
Chlorine	●	●	●	●	●			●	●		●	●	●	●				●	●				●					●	●	●	●			●			●	●	●		●		●	●	●	●				●	●	●				●						●	●	●	●	●	●	●		●	
Chromates				●	●				●	●				●	●								●					●												●		●	●	●	●	●	●	●	●	●														●						●	
CS_2	●			●											●	●			●												●						●	●	●	●		●					●	●	●														●		●		●				
Cysteine HCl	●	●	●	●	●			●	●		●	●	●	●		●		●					●					●	●	●		●		●		●	●	●	●		●		●	●	●	●				●	●	●				●						●		●	●	●	●	●		●	●
Dextrine																																																																							
Dextrose																																																																							
Diatomaceous earth																																																																							
Dipyridyl		●	●		●	●	●								●	●	●		●					●	●	●					●						●			●		●			●		●	●	●														●		●						
Dye, green			●		●					●					●								●					●												●		●	●	●			●	●	●	●														●						●	
Dye, red			●		●					●					●								●					●												●		●	●	●			●	●	●	●														●						●	
Dye, yellow			●		●					●					●								●					●												●		●	●	●			●	●	●	●														●						●	
Fuller's earth																																																																							
Glycene		●			●	●	●								●	●	●		●					●	●	●					●						●			●		●					●	●	●														●		●						
Graphite															●	●			●												●						●			●		●	●	●			●	●	●	●													●	●	●					●	
Hexachlorethane															●	●			●												●									●		●					●	●	●														●		●						
Hydrochloric acid	●	●	●	●	●			●	●		●	●	●	●		●		●					●					●	●	●		●		●		●	●	●	●		●		●	●	●	●				●	●	●				●						●	●	●	●	●	●	●		●	●
Iron oxide																			●											●																																	●								
Lactose																																																																							
Lard oil															●	●			●												●									●		●					●	●	●														●		●						
Lead oxide (red lead)														●	●																									●		●	●	●			●	●	●	●														●						●	
Magnesium carbonate				●		●	●				●	●			●		●		●												●				●		●	●	●	●	●	●	●				●	●	●	●														●		●	●	●		●	
Magnesium hydroxide	●	●	●		●			●	●	●	●	●	●	●	●	●		●	●				●					●	●		●					●				●	●	●	●	●	●	●	●	●	●	●	●	●				●						●	●	●	●	●		●		●	
Magnesium powder		●			●				●	●					●	●		●	●												●					●				●		●	●	●			●	●	●	●													●	●	●					●	
Metal powders		●			●				●	●					●	●		●	●												●					●				●		●	●	●			●	●	●	●													●	●	●					●	
Nitrates (inorganic)		●	●	●	●	●		●	●			●	●	●	●		●	●					●	●	●	●		●	●	●				●	●	●	●	●	●		●	●	●	●	●		●	●	●	●		●												●						●	
Nitrocellulose (wet)										●					●	●			●												●					●	●			●		●					●	●	●															●	●						
Perchlorates	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●					●	●	●	●		●	●	●				●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●				●						●		●		●	●	●		●	
Phosphorus, red		●		●	●	●	●			●			●		●	●	●		●					●	●	●			●		●				●	●	●	●	●	●		●			●		●	●	●			●										●	●		●		●				
Phosphorus, white		●		●	●	●	●			●			●		●	●	●		●					●	●	●			●		●				●		●	●	●	●		●			●		●	●	●			●										●	●		●		●				
Plant protein						●	●			●				●	●	●	●		●												●				●		●			●		●	●	●			●	●	●	●						●							●	●	●		●			●	
Potassium bicarbonate															●	●	●		●												●						●					●					●	●	●	●														●		●	●	●		●	
Potassium chlorate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●					●	●	●	●		●	●	●				●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●				●						●		●		●	●	●		●	
Potassium nitrate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●					●	●	●	●		●	●	●				●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●				●						●		●		●	●	●		●	
Protamine sulphate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●					●	●	●	●		●	●	●				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●				●						●		●		●	●	●		●	
Quaternary ammonium compound (50% solution)		●		●	●	●	●		●	●			●		●	●	●		●					●	●	●			●		●				●	●	●	●	●	●		●			●	●	●	●	●			●										●	●		●		●				
Raffinose															●	●			●												●						●					●					●	●	●																●						
Resin															●	●			●												●						●			●		●	●	●			●	●	●	●													●	●	●					●	
Silicone																																																																							
Silicone antifoams																																																																							
Skim milk solids																																																								●							●	●	●					●	
Soda, sodium bicarbonate						●	●								●	●			●												●						●					●			●		●	●	●						●										●			●		●	
Sodium chloride																																																																							
Sodium nitrate																																																																							
Sodium sulfate																																																																							
Sucrose																																																																							
Sugar, powdered																																																																							
Sulphur															●	●			●												●						●					●	●	●			●	●	●	●													●	●	●					●	
Sulfuric acid	●	●	●	●	●			●	●		●	●	●	●		●		●					●					●	●	●	●	●		●			●	●	●				●	●	●					●		●			●							●		●	●	●	●	●		●	●
Thermit		●		●	●	●	●			●			●		●	●	●		●					●	●	●			●		●				●			●	●	●		●			●		●	●	●			●			●							●	●		●		●				
Thiamine HCl	●	●	●	●	●			●	●		●	●	●	●		●		●				●	●					●	●	●	●	●		●		●	●	●	●		●		●	●	●	●				●	●	●			●	●						●	●	●		●	●	●		●	●
Thiourea										●					●	●			●												●						●			●		●					●	●	●															●	●						
Titanium powdered		●			●				●						●	●		●	●												●					●				●		●	●	●			●	●	●	●													●	●	●					●	
Tricalcium phosphate									●	●					●	●			●												●					●	●					●				●	●	●	●							●								●		●						
Tryptose																																																																							
Zinc borate		●		●	●	●	●		●	●			●		●	●	●		●					●	●	●			●		●				●	●	●	●	●	●		●			●	●	●	●	●			●			●	●						●	●		●		●				
Zinc oxide																			●												●																																●		●						

APPENDIX B

GEOLOGICAL PROFILES OF STUDY SITES

APPENDIX B

GEOLOGICAL PROFILES OF STUDY SITES

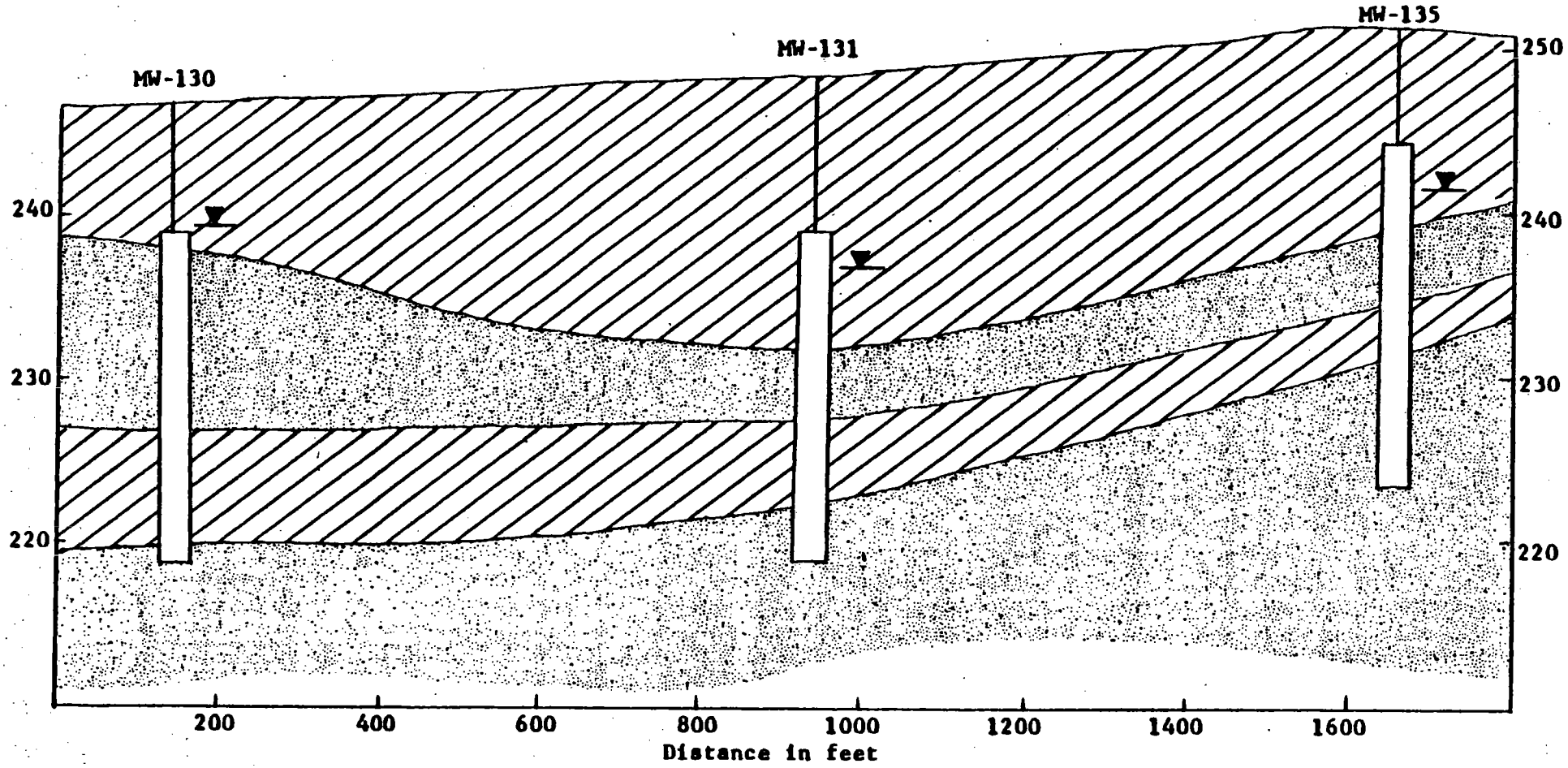
The geologic descriptions and generalized geologic sections contained in this appendix were developed from information gathered during the drilling, construction, development, and testing of 53 monitoring wells sited around selected PBA waste disposal facilities. With the exception of a few borings where caving sands required use of a rock bit and artificial drilling fluid, the material descriptions were based on auger samples. A geologist with experience in well logging procedures logged the borings and inspected the well construction.

The data contained herein are generalized, intended only to provide an overview of geohydrologic conditions at the sites where closure plans are required. Subsurface information obtained from the monitoring well program is not, nor was it designed to be, sufficient in detail for the development of final closure plan design.

SITES 7a, 7c, AND 7d

The toxic storage yard (TSY) and the sites located immediately to the south are situated upon Pleistocene terrace deposits. A sandy clay stratum, ranging in thickness from 10 to 17 feet occurs at the surface. The two abandoned borrow pits of Site 7d are situated in this stratum. Underlying this sandy clay are alternating beds of saturated, silty fine sands and sandy clays. (See section). Ground water occurs at a depth of 8 to 12 feet below ground level under water table conditions.

The surface drainage originating at these sites drains into both the Phillips Creek drainage system to the north and into a tributary of Phillips Creek to the south. Water surface elevations of surrounding ground water monitoring wells suggest that the direction of ground water flow is the same as surface drainage, with the ground water gradient being controlled regionally by the Arkansas River to the east.

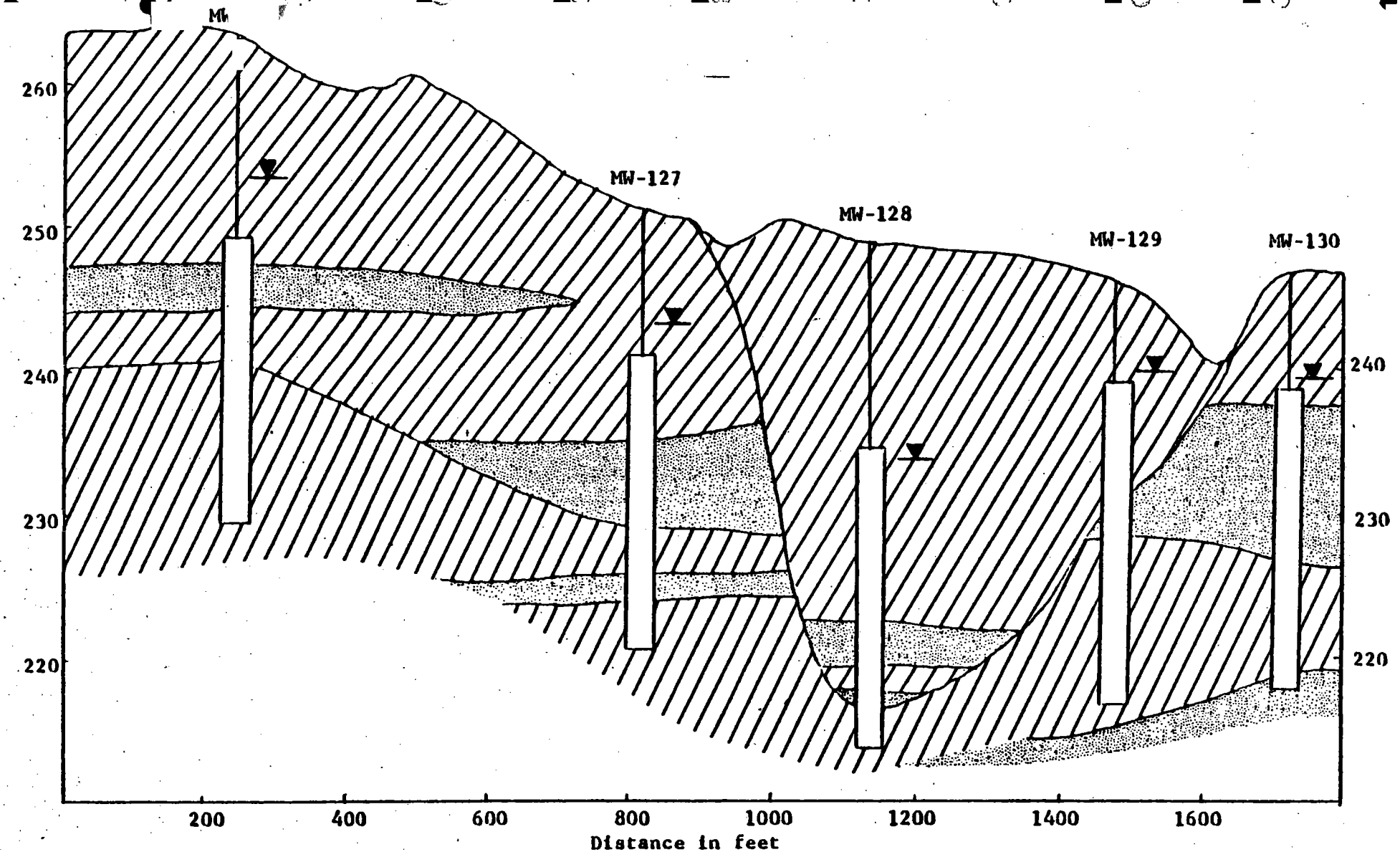


Generalized geologic profile along

southern boundary of toxic storage yard

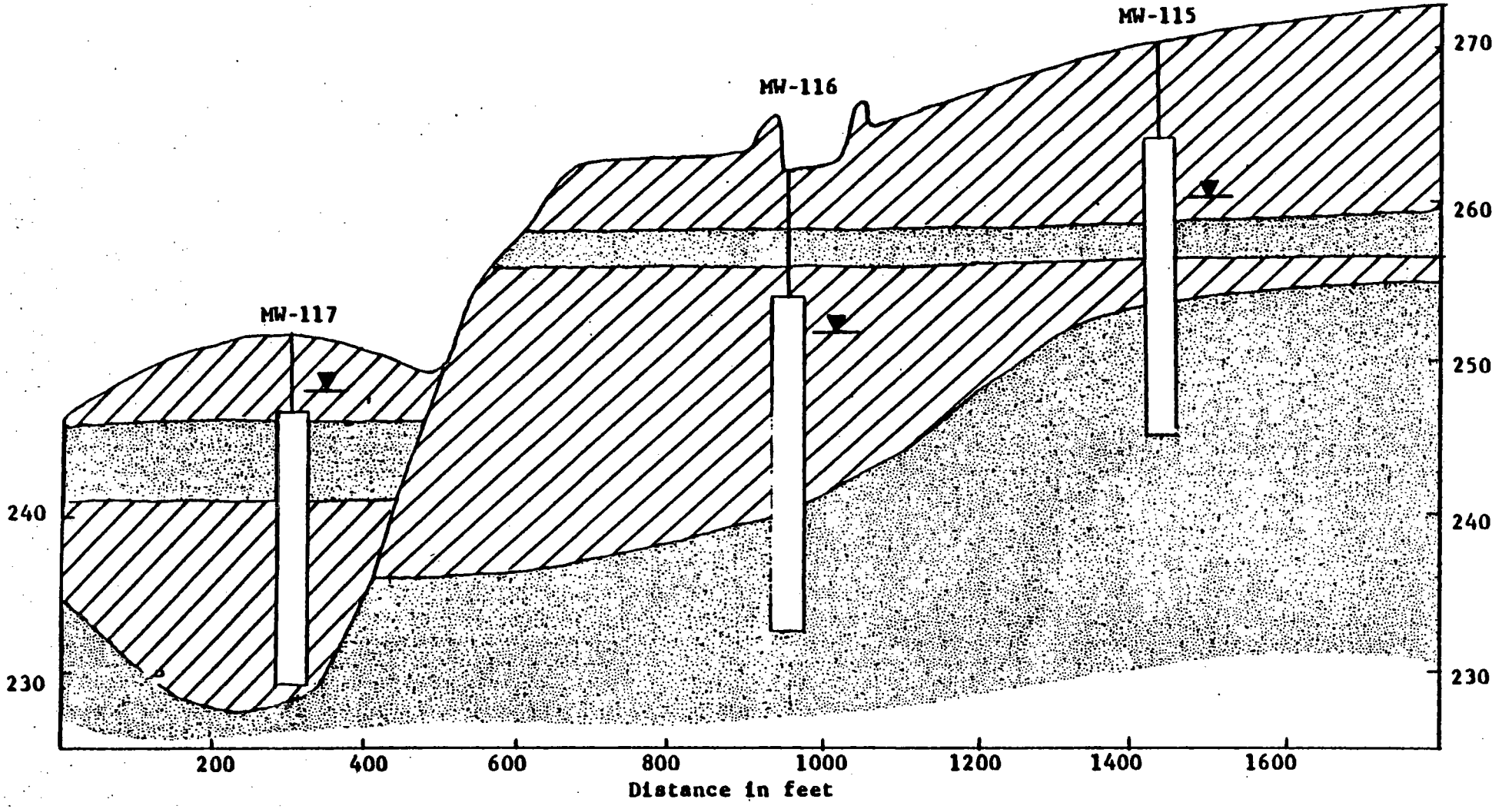
SITES 11a, 11b, AND 11c

Sites 11a, 11b, and 11c are sediment retention basins consisting of dikes constructed across tributaries of Phillips Creek. These tributaries dissect terrace deposits consisting of alternating sandy clays and silty fine sands. (See section). Logs of nearby monitoring wells indicate that Recent alluvial sediments are present in the stream channels immediately downstream of the dikes at Sites 11b and 11c. Ground water underlying the sites is encountered at a depth approximately 8 to 10 feet below ground surface. The ground water gradient is towards the Arkansas River to the northeast.



Generalized geologic profile of sites 11c & 7b

(SRB-3, area 5 & Lewisite disposal site)



Clay

Sand

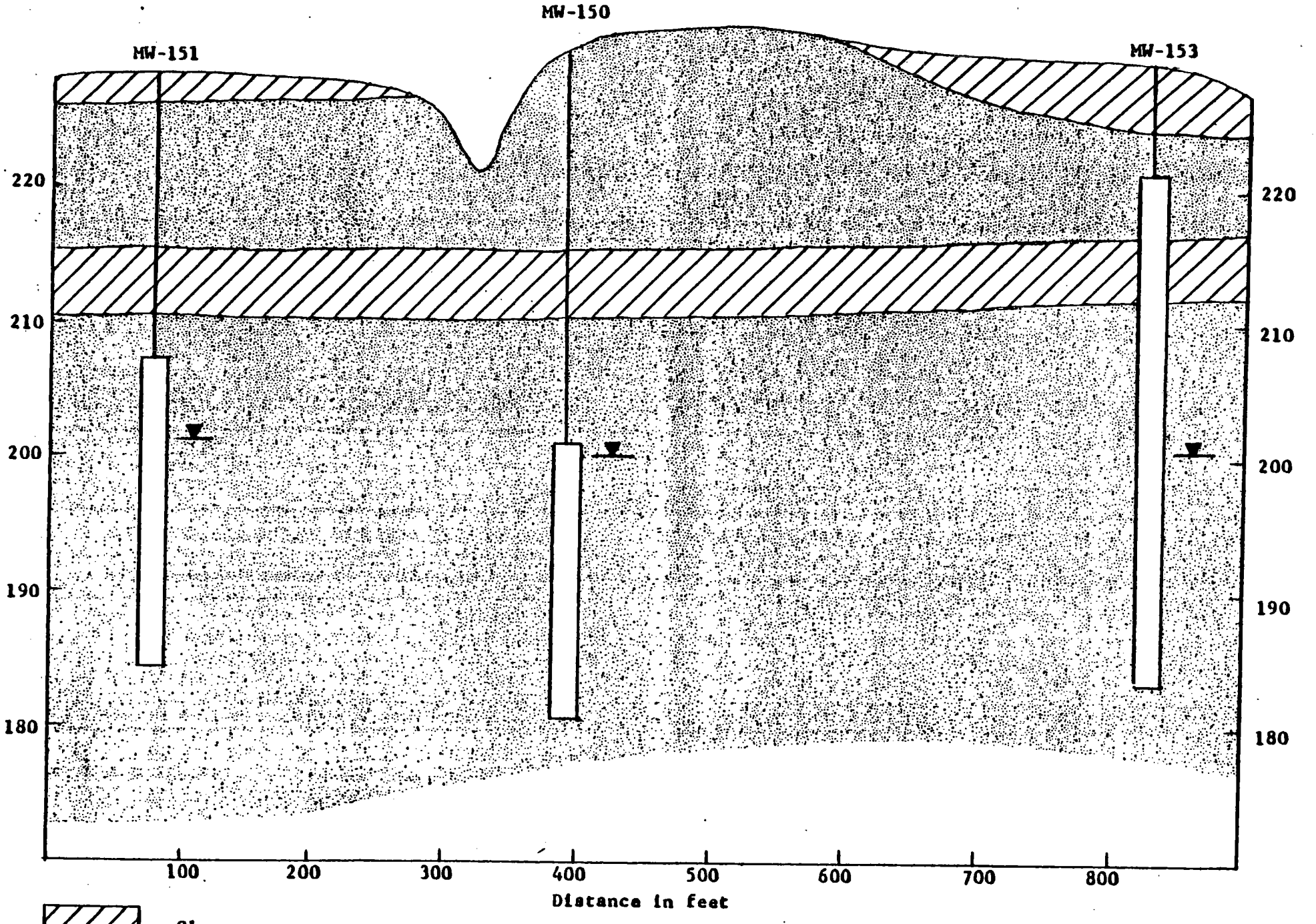
Water level as of December 1981

Generalized geologic profile of sites

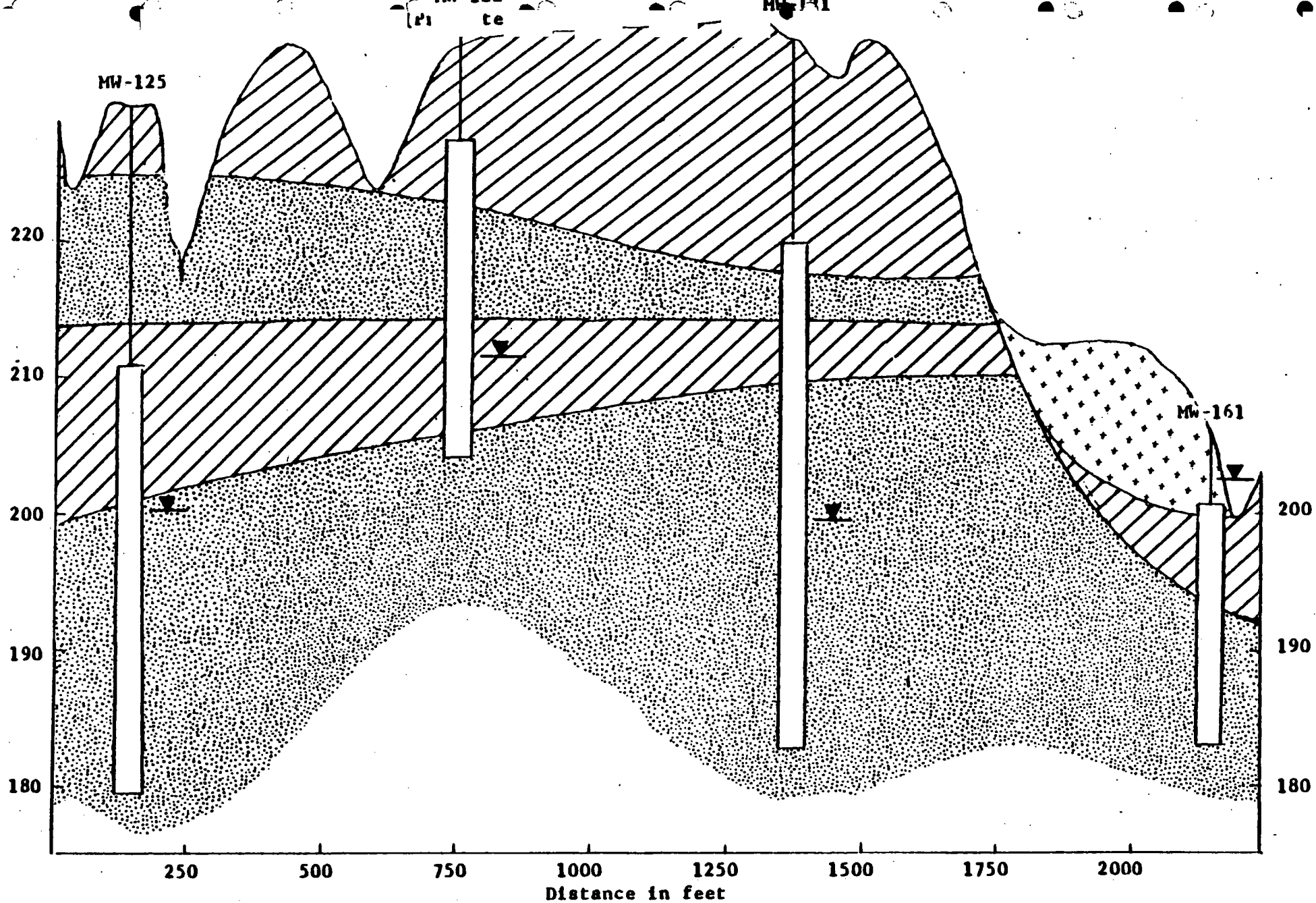
11a & 11b (SRB-1, area 5 & SRB-2, area 5)

SITES 36, 40, 42, 24, 27, 26, AND 38

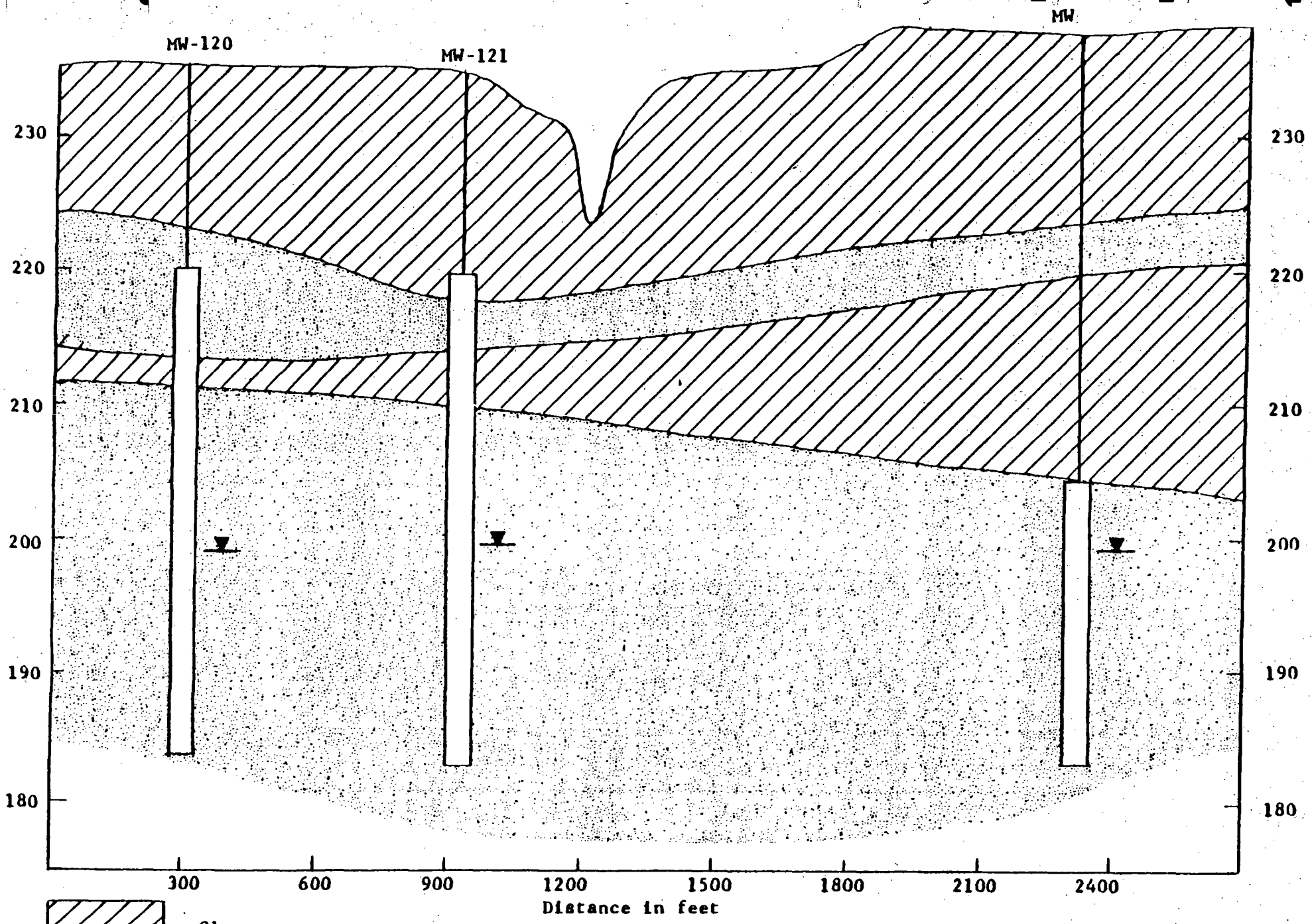
The subject sites are situated upon terrace sediments whose thickness is in excess of 50 feet. Ground water monitoring wells in the general area have not penetrated the total thickness of the terrace deposits. These deposits consist of alternating beds of silty fine sand and sandy clay. An upper sand unit, persistent throughout the area, contains perched ground water supported by an underlying impervious clay. This water was encountered at depths between 10 and 15 feet below ground level. (See sections). The depth to the static water table ranges from 31 to 35 feet below ground surface at approximately elevation 200 feet MSL. This elevation is relatively consistent throughout the entire area circumscribing the subject sites, with the ground water gradient in the direction of the Arkansas River to the northeast.



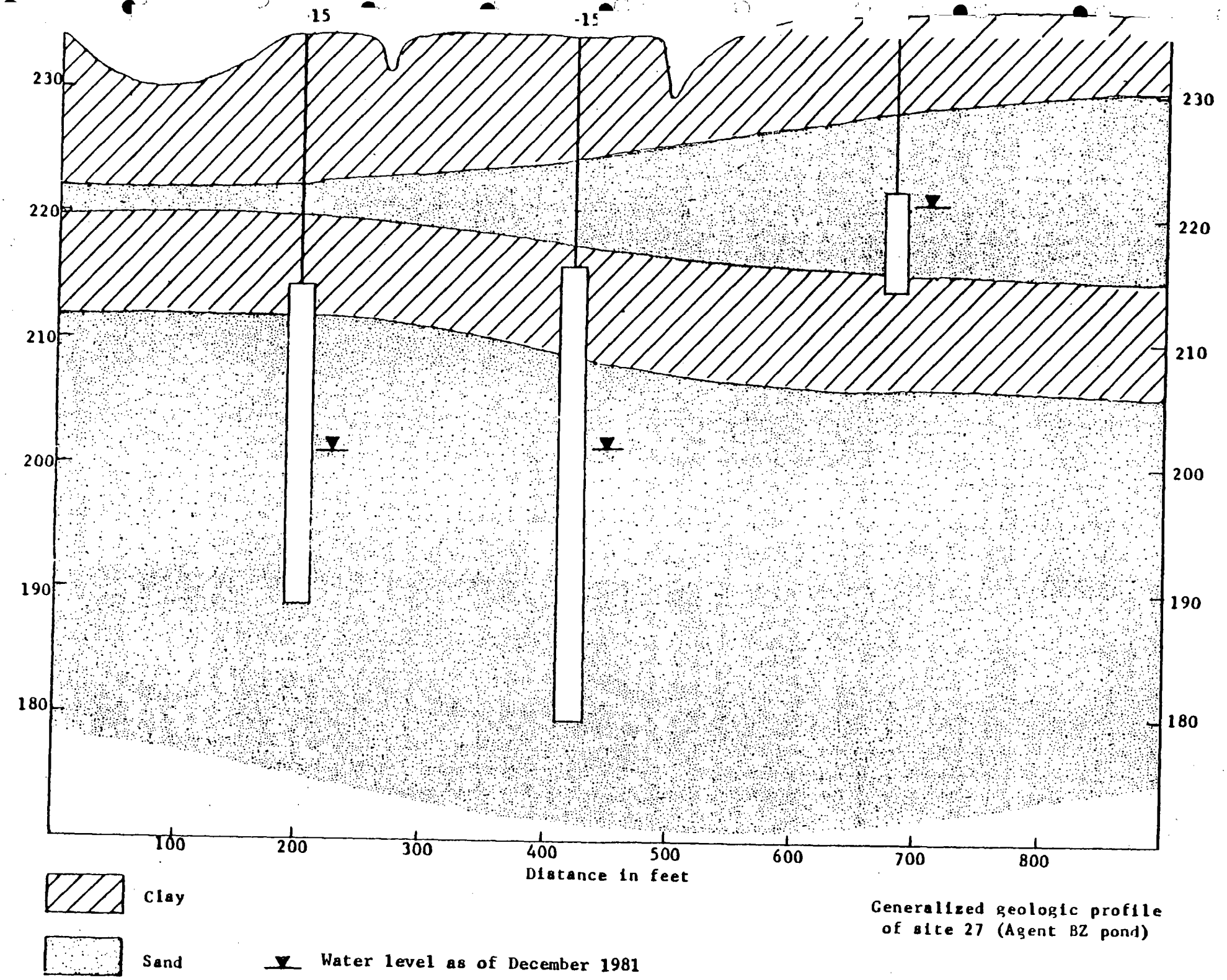
Generalized geologic profile of site 24 (Thermite waste disposal area)



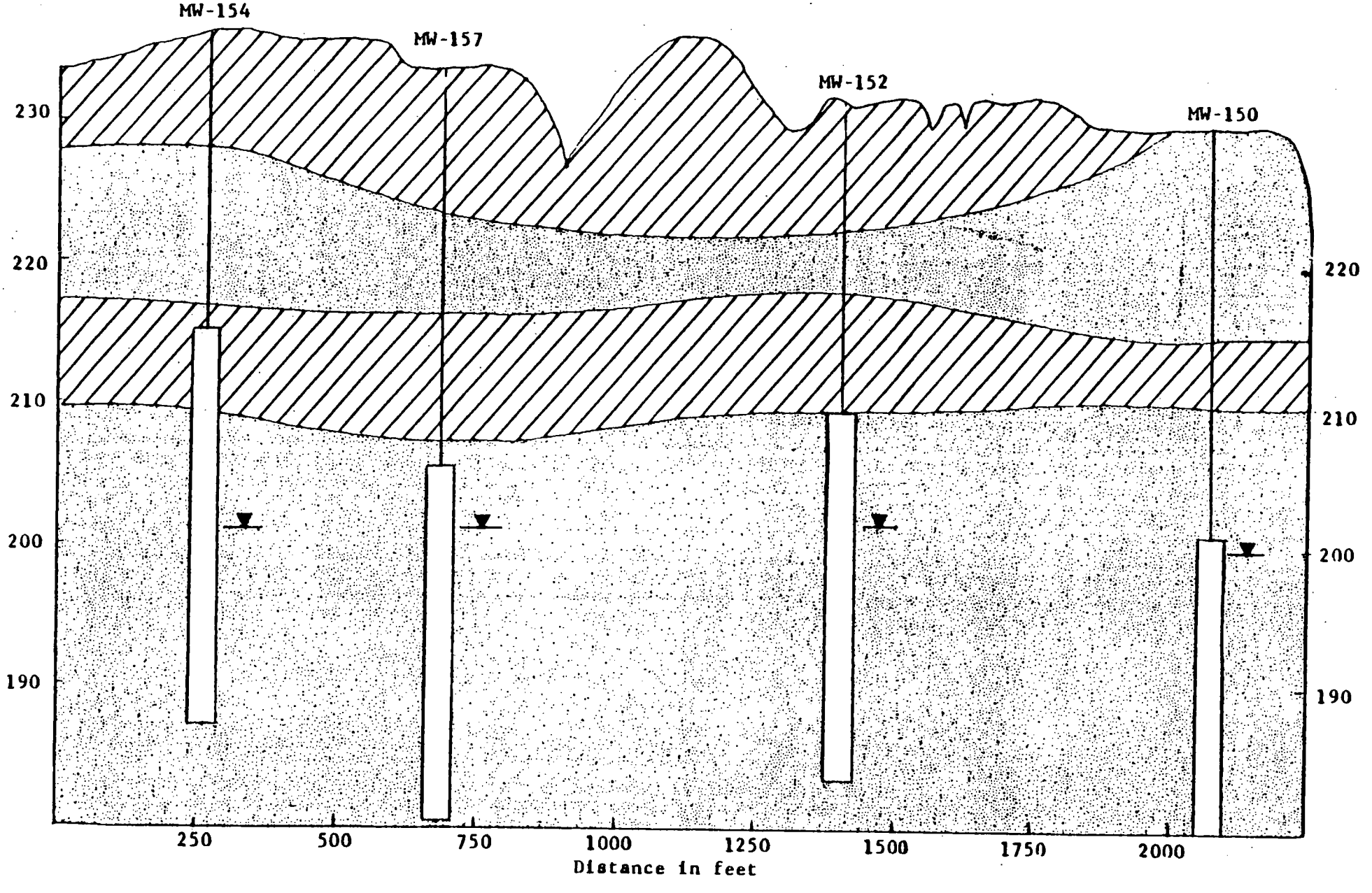
Generalized geologic profile of site 36 (MCA-72, sludge lagoons) and site 20a (depot S. burn pit/storage site)



Generalized geologic profile of site 36 (MCA-72, sludge lagoons)



Generalized geologic profile of site 27 (Agent BZ pond)

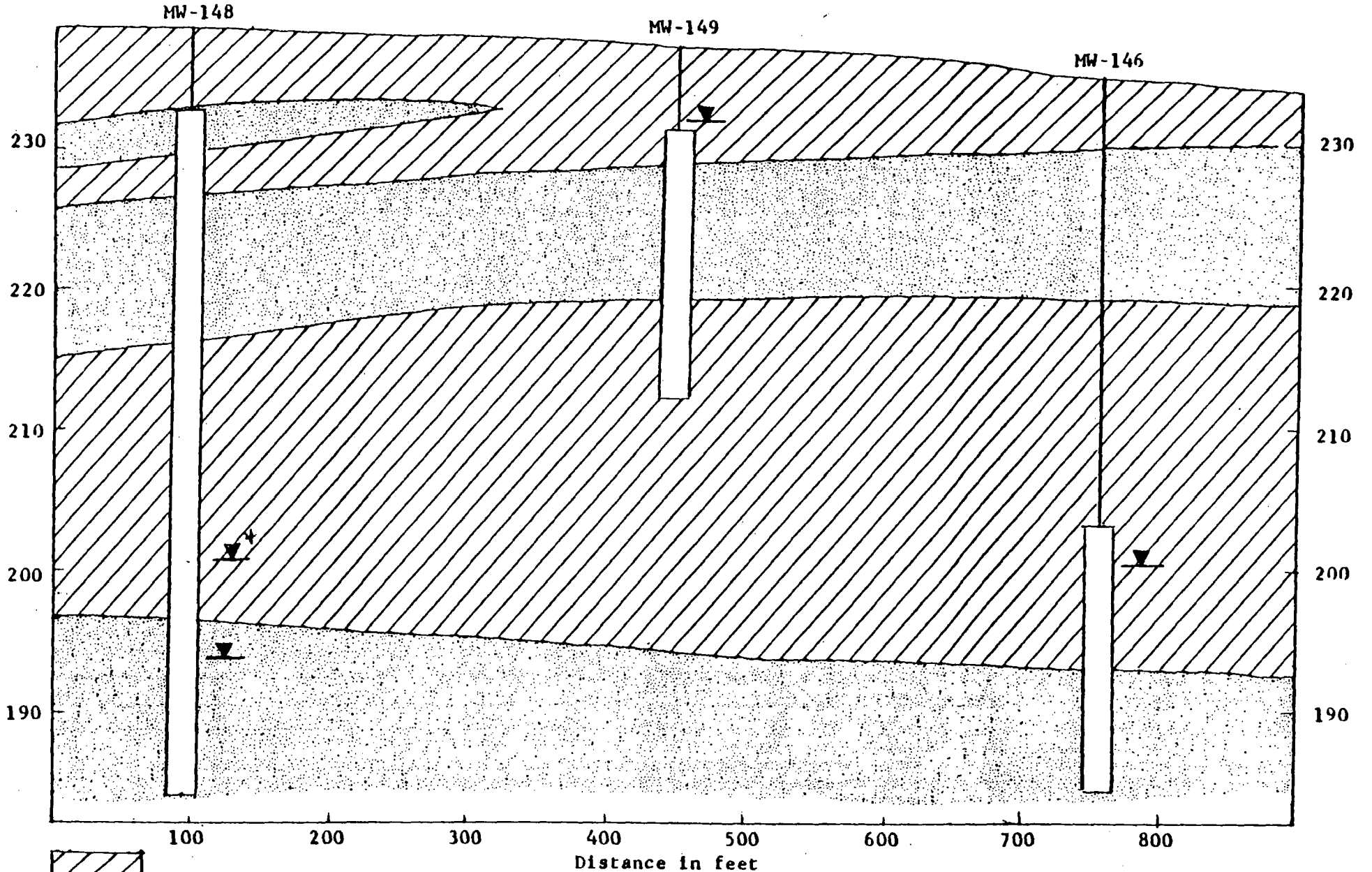


Generalized geologic profile of site 27 (Agent BZ pond) and site 24 (Thermite waste disposal area)

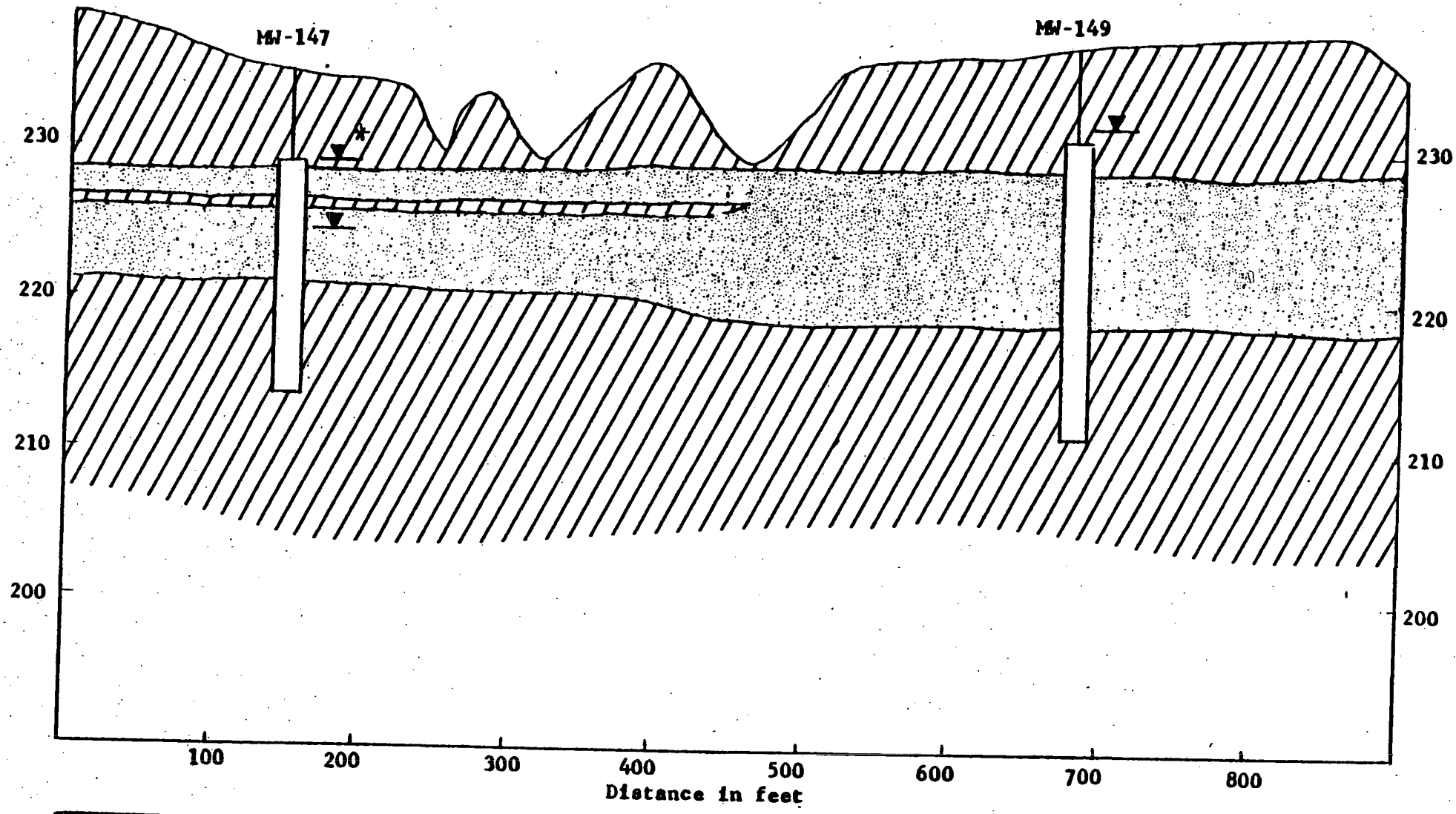
SITES 23a, 31a, AND 31b

The White Smoke Test Pond is situated on a thick sequence of Pleistocene terrace deposits. A slightly sandy clay stratum from 5 to 8 feet thick occurs at the surface of the area and contains the test pond. Beneath this lies a saturated fine-grained silty sand bed which, in turn, overlies alternating beds of sandy clays, and silty sands. (See sections). Drilling showed the sequence to be at least 55 feet thick containing two water bearing zones. A perched water table was encountered at a depth from 4.5 to 6.0 feet below ground level in an upper silty sand bed. The water table occurs much deeper in a lower sand strata at elevation 200 feet MSL. Monitoring well information was insufficient to determine the direction of ground water flow. It is assumed that the local gradient parralels the regional gradient to the northeast.

Sites 31a and 31b are located southwest of the test pond. Although no monitoring wells were installed in these areas, their proximity to Site 23a indicates that the stratigraphy and ground water conditions are similar.



Generalized geologic profile of site 23a (HC test pond and dump area)



Generalized geologic profile of site 23a

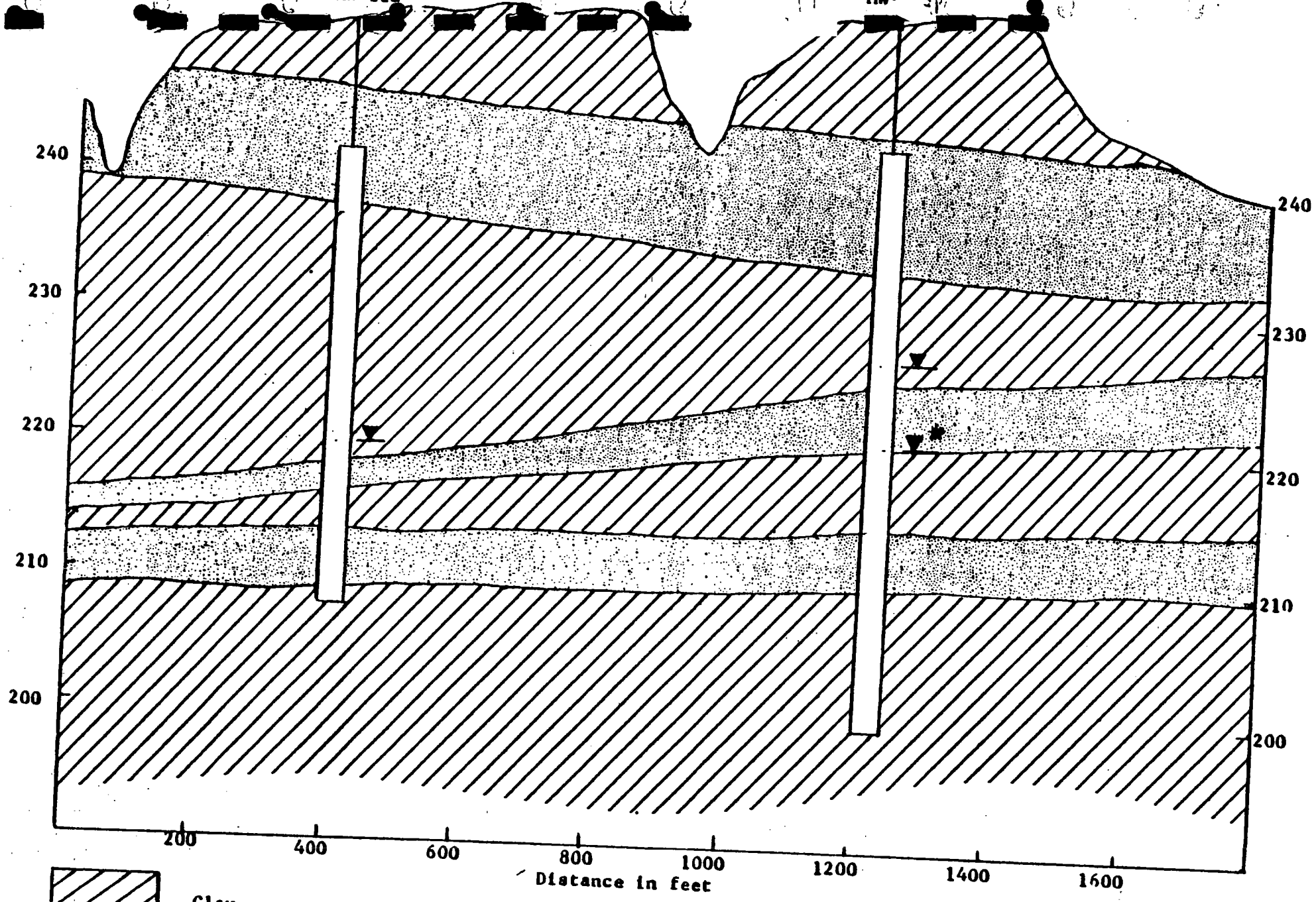
(HC test pond and dump area)

SITE 35

The north oxidation pond is underlain by approximately 43 feet of Pleistocene terrace deposits consisting of alternating beds of sandy clay and fine sand. The Jackson Group, encountered below the terrace sediments, consists of a firm, blue-green impervious clay shale. (See section).

During the drilling operations for the installation of the monitoring wells, small amounts of water were noted perched in a shallow sand immediately above an impervious clay. This perched water was encountered between 12 and 16 feet below ground level. Subsequent readings of water levels in nearby monitoring wells indicate this perched water to be either seasonal in nature or of such a small amount that it is not reflected in the water level measurements in the monitoring wells.

A static water level occurs approximately 32 feet below ground surface. The directon of ground water flow is northeast towards Phillips Creek and the Arkansas River.



Generalized geologic profile of site 35 (Oxidation pond)

SITE 43

Site 43, the white phosphorus production area, is situated upon Pleistocene terrace deposits. Borings for ground water monitoring wells in the general area indicate terrace deposits of fine sands and sandy clays in excess of 50 feet in thickness. Ground water, as indicated by surrounding monitoring wells, occurs at elevation 200 feet. This would be at a depth of approximately 45 feet.

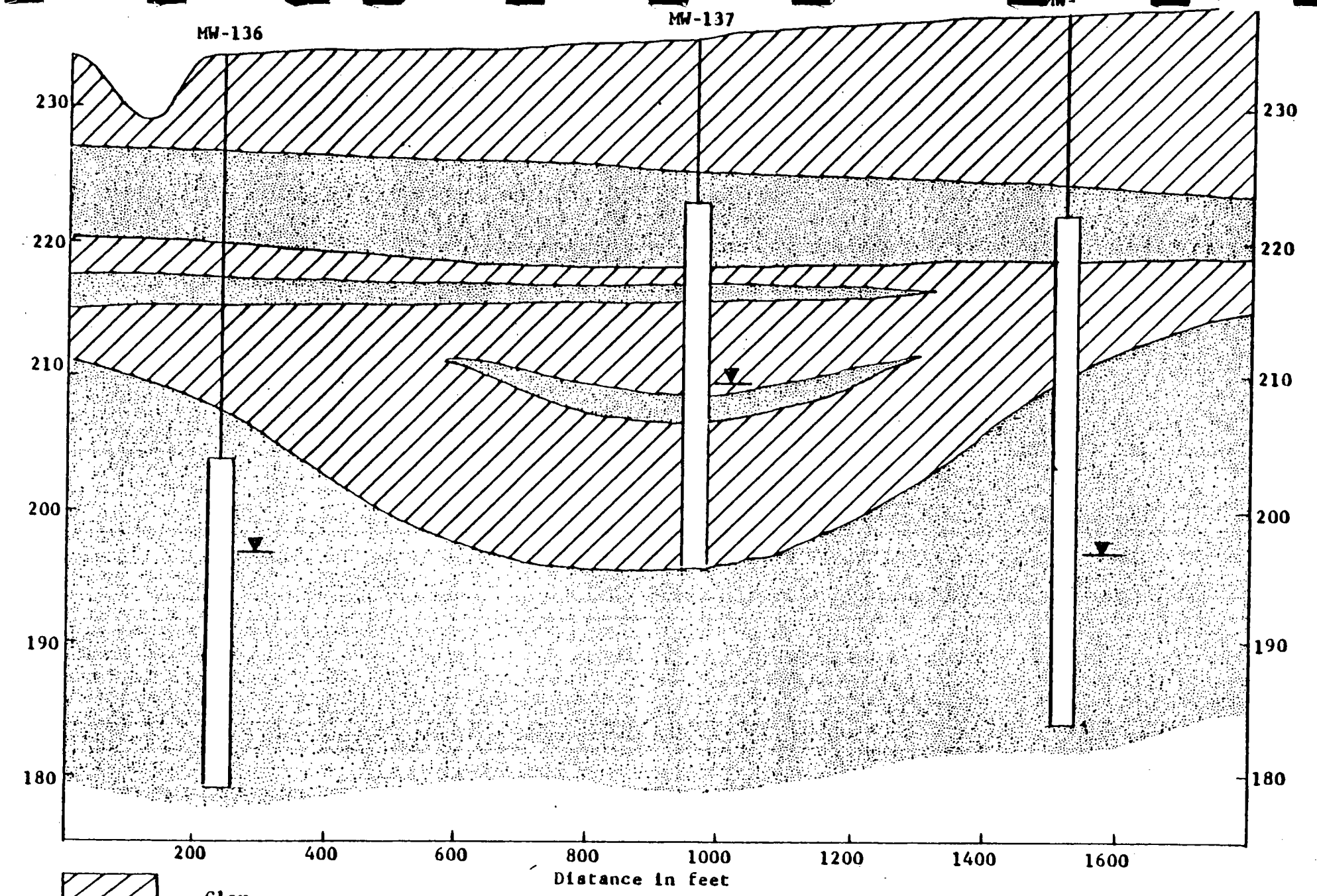
SITE 7 B

The abandoned Lewisite Disposal Area is situated within the drainage basin of a small tributary of Phillips Creek. This small drainage has dissected Pleistocene terrace deposits and developed an alluvial channel filled with approximately 32 feet of sediments consisting of silty and sandy clays and silty fine sands. The terrace deposits average 22 feet in thickness and consist of a silty and sandy clay overlying a basal fine sand. Bedrock consists of a firm clay shale of the Jackson Group. Ground water in the Pleistocene terrace deposits is generally encountered from 6 to 10 feet below ground level. Ground water in the Recent alluvium occurs at depths in excess of 15 feet (see the generalized geologic profile of Sites 11c and 7b). Locally, the hydraulic gradient slopes east towards the Arkansas River.

SITE 10

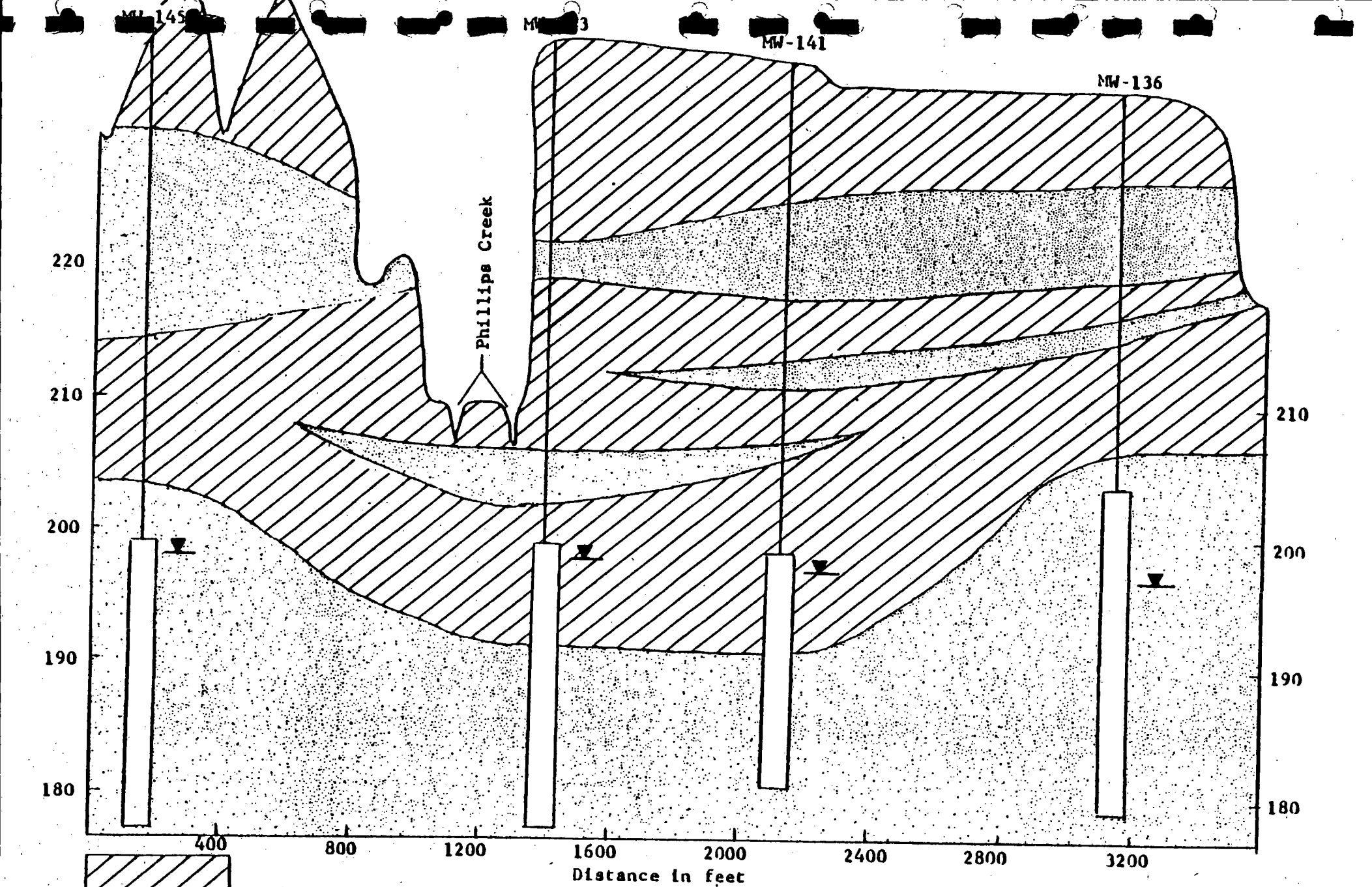
The West Bombing Mat is underlain by a complex sequence of Pleistocene terrace deposits at least 60 feet thick. The surface stratum consists of a silty clay approximately 10 feet thick. This is underlain by an 8-foot thick silty sand bed which, in turn, overlies alternating beds of sandy clays and silty sands. (See sections). The total thickness of the terrace deposits was not penetrated while drilling for the monitoring wells.

Some perched water was encountered at 25 feet below ground level in a deep sand strata during the drilling of MW-139 in the southeast corner of the study area. Ponded water and vegetation indicative of swampy conditions were observed in several trenches excavated across the site, which may be representative of perched water conditions or surface runoff. Ground water stabilized at elevation 198.5 feet MSL on the eastern edge of the area and at elevation 199.5 feet MSL on the western edge of the area. Monitoring wells surrounding the site confirm that the direction of ground water gradient is generally to the northeast.

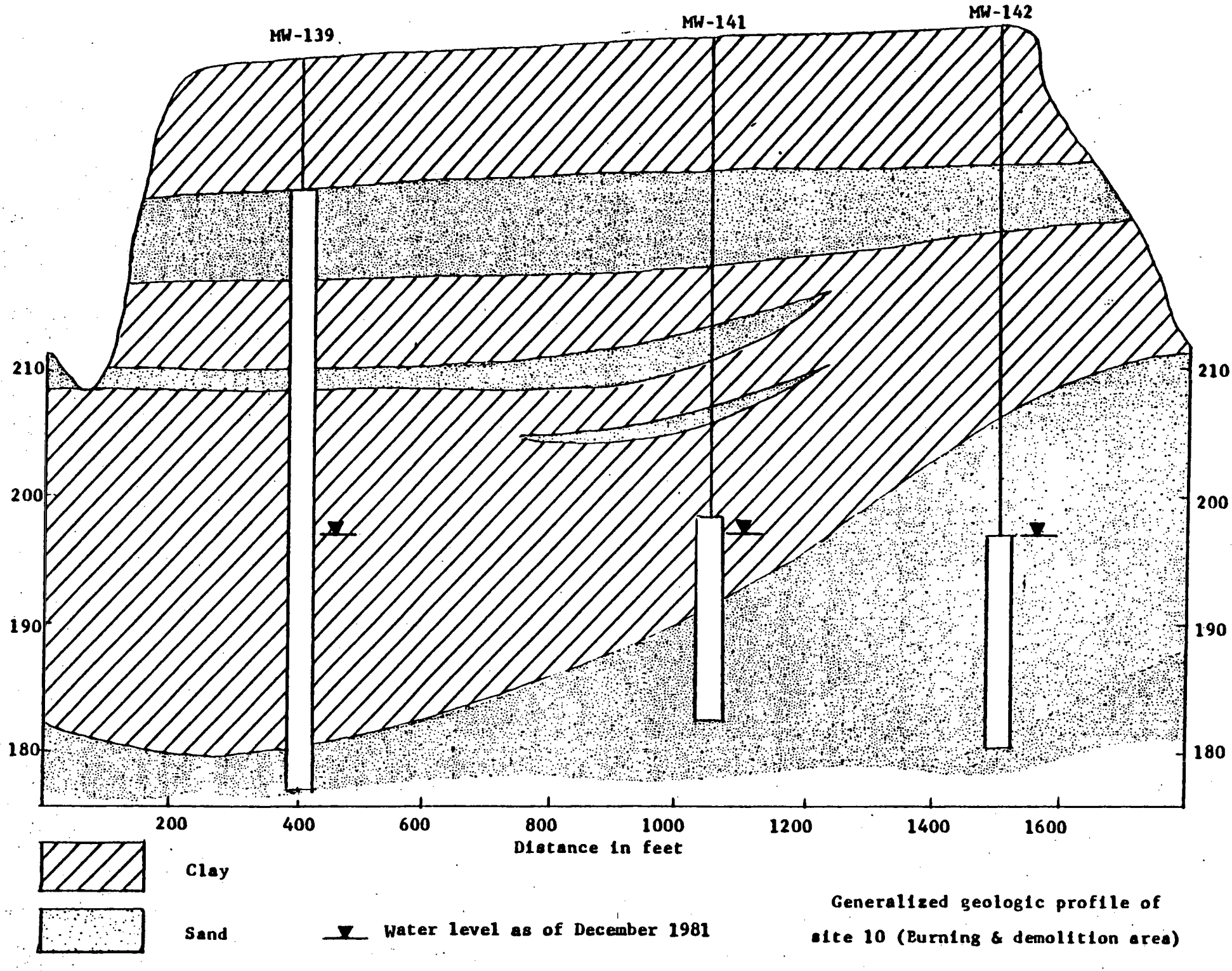


Generalized geologic profile of

M-74 rocket test firing range



Generalized geologic profile of site 10 (Burning and demolition area) and M-74 rocket test firing range



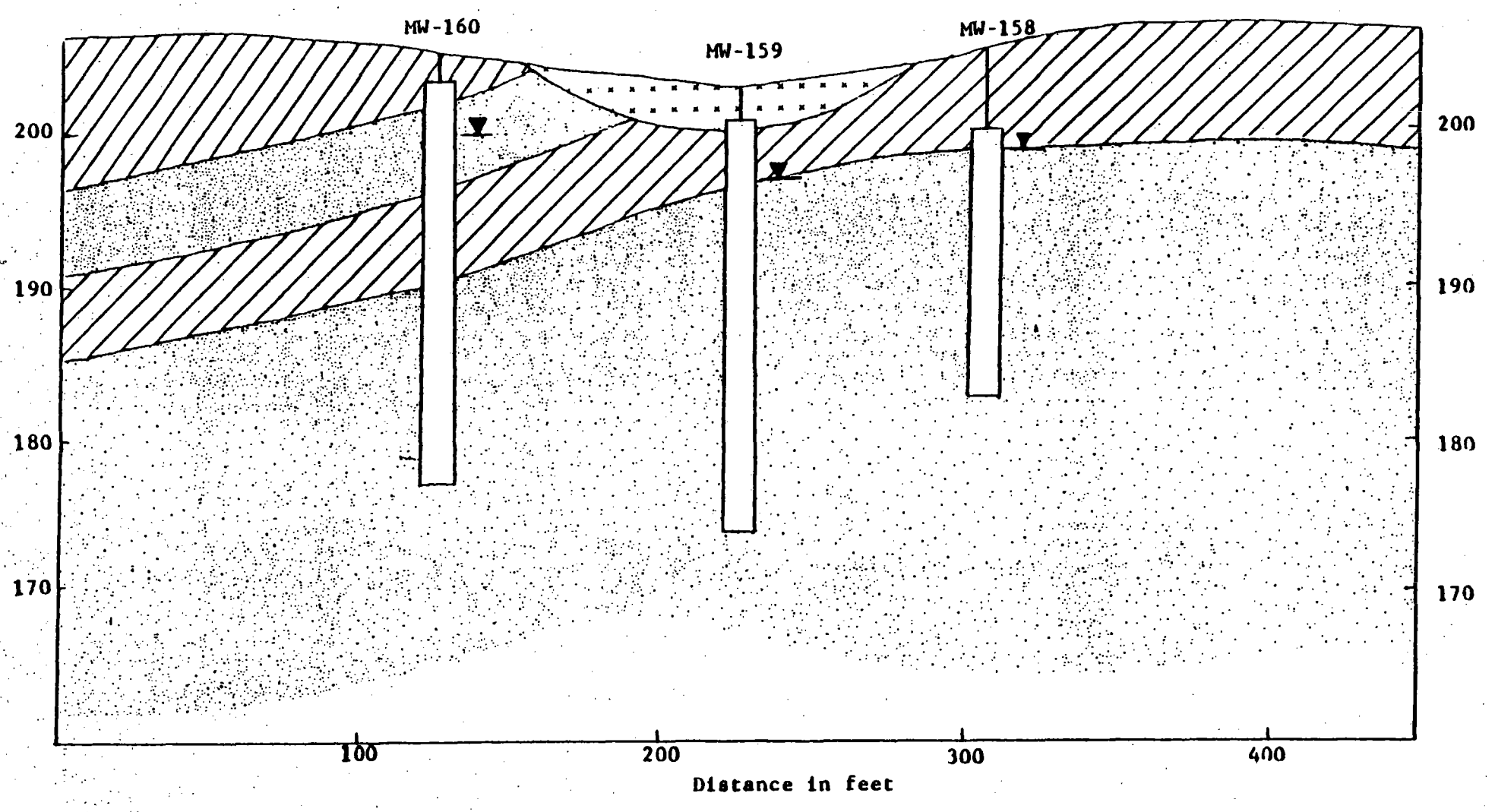
Generalized geologic profile of site 10 (Burning & demolition area)

SITE 17

The Product Assurance Test Range and dump site are located along the southern shore of Yellow Lake. An escarpment along the northern edge of the site defines a boundary between Recent alluvial deposits to the north and Pleistocene terrace deposits to the south.

Monitoring wells were installed in the northwest corner of the area at the base of the escarpment. These wells penetrated Recent alluvial deposits consisting of alternating beds of sandy clays and coarse to fine sands. The total thickness of these deposits was not defined while drilling. However, they are at least 29 feet thick and consist primarily of an upper sandy clay layer 10 to 15 feet thick overlying saturated sands. Approximately 3 feet of fill material occurs at the surface of MW-159 due to the dumping activity at the site. (See section).

No monitoring wells were drilled south of the escarpment in the study area. However, data from surrounding wells and topography indicate that this larger portion of the site is situated on a thick sequence of Pleistocene terrace deposits consisting of alternating beds of silty sands and clays. Surrounding monitoring wells indicate that there is a slight ground water gradient towards Yellow Lake, with the regional gradient being controlled by the Arkansas River to the northeast. Static water levels in the alluvial deposits occur at elevation 199 feet MSL.



Generalized geologic profile of site 17 (PA test and dump site)

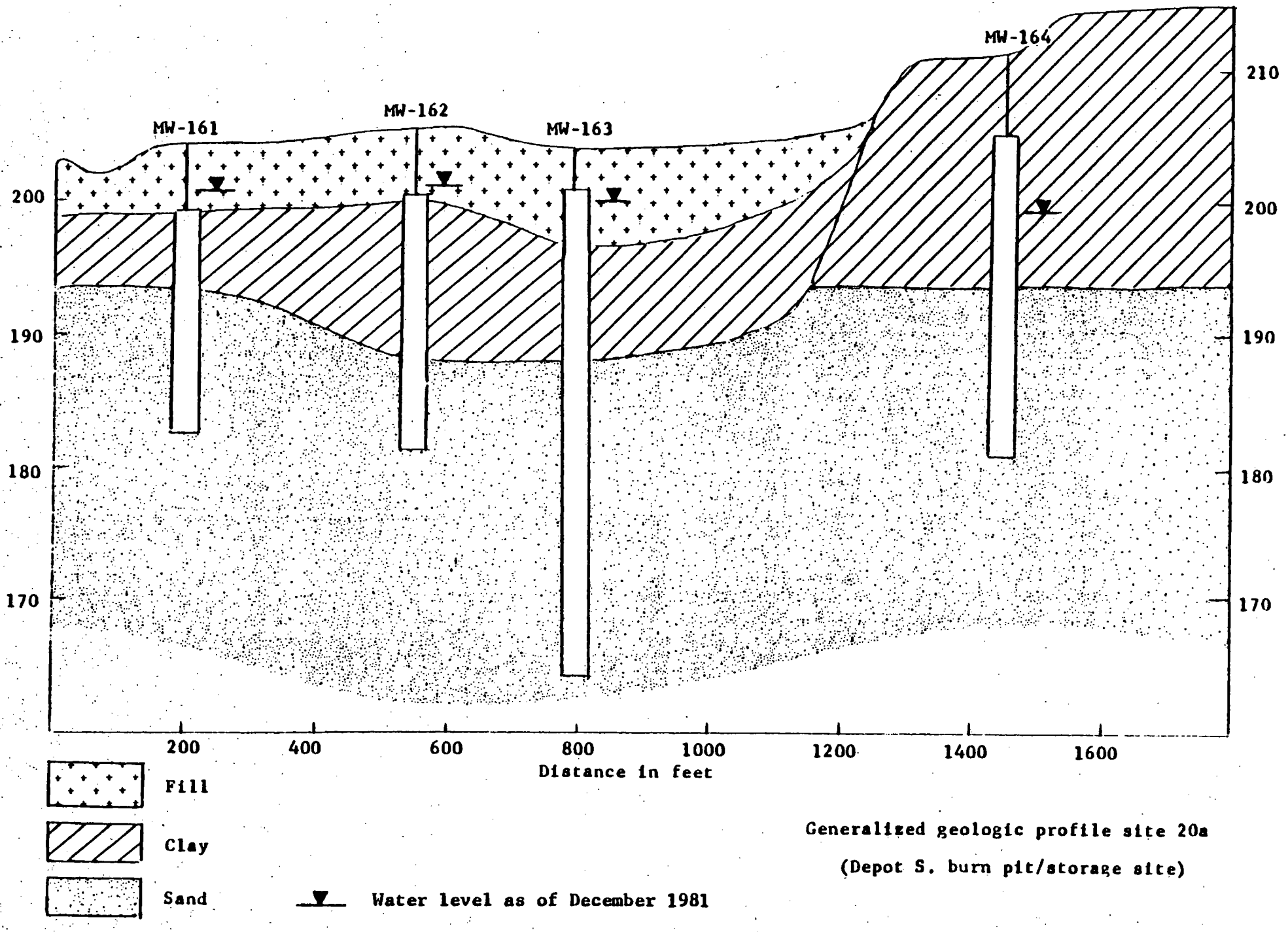
SITES 20a AND 20b

Sites 20a and 20b are located adjacent to a swampy wetland. Drilling at Site 20a indicates that the site is situated on fill overlying alluvial deposits. The surface fill material is from 5 to 10 feet thick and is due to dumping at the site. The underlying alluvium consists of a fat impervious clay stratum approximately 10 feet thick. This clay stratum, in turn, overlies a sequence of terrace deposits of alternating silty sand and sandy clay strata at least 24 feet thick.

The study area is bounded along the southwestern edge by a slope defining the boundary between alluvial and terrace deposits. The total thickness of the terrace deposits along this boundary was not defined by drilling. However, the drilling of monitoring wells in nearby areas indicate a thickness in excess of 52 feet of alternating silty clay, silty sand, and sand clay beds (See sections).

Ground water is very shallow at the site, occurring in the fill material from 2 to 7 feet below ground level at the same elevation as the adjacent swamp. The terrace deposits to the southwest show ground water stabilizing at elevation 200. The ground water gradient is generally northeast towards the swamp and the Arkansas River.

Site 20b is adjacent to Site 20a, lying to the southeast. Although no monitoring wells were installed in this area, topography and nearby wells indicate that the stratigraphy is similar to that of Site 20a.



Generalized geologic profile site 20a

(Depot S. burn pit/storage site)

SITE 2

Based on topography and gelogic information obtained from the drilling of Site 35, the site is situated on Pleistocene terrace deposits of alternating silty clays, sandy clays, and silty fine sands approximately 40 feet thick. This sequence is underlain by the blue-green clay shale of the Jackson Group. No ground water information is available at the site. However, perched water could likely be encountered in some upper sand beds. The ground water gradient is controlled by the Arkansas River to the east.

SITES 4a, 29, AND 29a

Based on topography and geologic information obtained from the drilling of sites 11a, 11b, and 11f, the subject sites are situated on a thin blanket of terrace deposits overlying the clay shale of the Jackson Group. There is a possibility of perched water occurring in some upper sand strata. Regional ground water gradient is to the east.

SITE 12

The old mustard dump site is adjacent to the Arkansas River and is situated on Recent alluvium. No drilling was done at this site. However, it is likely that ground water occurs very shallow, approaching the elevation of the river.

SITE 13a

Based on topography, this site is situated on a thick sequence of Pleistocene terrace deposits at least 50 feet thick. Although no drilling was done at the site, it is likely that ground water occurs at the regional level of 200 feet MSL and flows to the northeast.

SITE 34

Site 34 is situated in an area of Pine Bluff Arsenal where the outcrop of the Jackson Group has been mapped. Although no borings have been drilled at the site, an extensive stratigraphic study was conducted in the extreme northwest corner of the Arsenal. This study indicated that a residual soil consisting of silty clay has developed upon the Jackson Group. This soil mantle averages 5 - 10 feet in thickness. The Jackson Group consists of a silty and sandy clay-shale. Ground water in the above referenced study area occurs at depths between 20 - 25 feet below ground surface. Similar geologic conditions are believed to exist at the subject site.

APPENDIX C

INSTALLATION SPILL CONTROL PLAN (ISCP)

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INSTALLATION SPILL CONTROL PLAN (ISCP)

I. INTRODUCTION.

1. Purpose. The purpose of this plan is to establish the responsibility, duties, procedures, and resources to be employed, to contain and clean-up accidental discharges of oil and hazardous substances on Pine Bluff Arsenal, and to be prepared to provide assistance to non-DA agencies when requested.

2. SCOPE. This plan applies to all personnel assigned to or employed by Pine Bluff Arsenal.

II. DEFINITIONS.

1. Oil. Any oil of any kind or in any form including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

2. Oil Slick. The presence on the river of any significant quantity of oil, regardless of source.

3. Hazardous Substance. An element,compound or mixture (other than oil) which, when discharged in any quantity onto land or into or upon navigable waters, presents an imminent and substantial danger to the public health or welfare, including fish, shellfish, wildlife, shoreline and beaches.

4. Discharge. Includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping.

5. Discharge Classifications. The following classifications do not denote the degree of hazard to the public's health or welfare, or measure environmental damage. A discharge that poses a substantial threat to the public health or welfare or results in critical public concern will be classified as a major discharge, notwithstanding the following quantative measures.

a. Minor Discharge. A discharge to the Arkansas River of less than 1,000 gallons of oil.

b. Medium Discharge. A discharge of 1,000 to 10,000 gallons of oil to the Arkansas River, or a hazardous substance in a harmful quantity as defined in EPA or Army Regulations.

c. Major Discharge. A discharge of more than 10,000 gallons of oil to the Arkansas River, or a discharge of a hazardous substance that poses a substantial threat to the public health or welfare.

6. Spill Event. A discharge of oil or a hazardous substance on land or into or upon the navigable waters of the United States or adjoining shorelines in harmful quantities.

7. Removable Substances. Those that have oil-like physical characteristics and have been listed as removable by EPA in the Federal Register, Volume 43, pp 10488-89, 13 March 1978.

8. Installation On-Scene Commander (IOSC). The official predesignated by the Army Installation Commander to coordinate and direct Army control and clean-up efforts at the scene of an oil or hazardous substance discharge on or adjacent to an Army Installation.

9. Installation Response Team (IRT). Those individuals on an installation designated to act in an emergency to perform those functions directed by the IOSC.

10. Regional Response Team (RRT). A team of Federal regional representatives of the primary or selected advisory agencies, which acts within its region as an emergency response team.

11. Regional Response Center (RRC). The Federal regional site for the control of Pollution emergency response activities. It provides communications, information, storage, and necessary personnel and facilities to promote the proper functioning and administration of regional pollution emergency response operations.

III. PLAN OF INSTALLATION PROVISIONS RELATING TO SPILLS.

1. Policy. A capability will be established and maintained in response to emergency situations to promptly contain and clean up accidental DA-caused oil discharges and spills of hazardous substances that occur at or near Pine Bluff Arsenal. Assistance will also be provided to contain and clean up non-DA-caused spills under provisions of the National Oil and Hazardous Substances Pollution Contingency Plan consistent with operational commitments.

2. General Provisions Relating to ISCP.

a. When a spill occurs, responsive actions will be taken to prevent oil and/or hazardous substances from entering any navigable waters or water supplies.

b. The RRT will be activated upon request of the PBA Environmental Coordinator if a major or potentially major discharge occurs. In any other pollution emergency, the RRT may also be activated upon oral request by any primary agency representative to the chairperson of the RRT. Requests for team activation will be confirmed in writing.

c. During a major pollution discharge involving activation of the RRT, the IOCS may be directed and controlled by the EPA or USCGOSC.

d. PBA will establish a thorough training program for oil spill response personnel.

e. This plan will be reviewed and evaluated at least once every three years.

IV. DISCOVERY AND NOTIFICATION OF DISCHARGES.

1. Initial Report - In-House Notification.

a. Duty Hours. Any individual who discovers an accidental discharge of oil or a hazardous substance should report the discharge immediately to the IOSC, ext. 2538, and to his immediate on-site supervisor.

b. After-Duty Hours. Any individual who discovered an accidental discharge of oil or a hazardous substance should report the discharge immediately to Guard Headquarters and the Staff Duty Officer, ext. 2711.

2. Secondary Report - In-House Notification.

a. Duty Hours. The IOSC will direct notifications of the IRT, Installation Commander and to the Chief, Plans Office.

b. After-Duty Hours. The Staff Duty Officer will notify the Fire Department, the IOSC, and the Installation Commander.

V. CONTAINMENT, COUNTERMEASURES, CLEAN-UP AND DISPOSAL.

1. Departmental Responsibilities.

a. Installation Commander in coordination with responsible officers of the SPCCP will simulate the ISCP at least annually in order to ensure effective personnel and equipment response in the event of an accidental discharge.

b. Director of Facilities Engineering will:

(1) Be the Installation On-Scene Commander, (IOSC).

(2) Coordinate and direct clean-up efforts.

(3) Provide office of record and ensure the maintenance of this plan.

(4) Assure the readiness of the Fire Prevention and Protection Division to support clean-up procedures.

(5) Assure personnel accomplish procedures for detection of spills at oil storage and transfer facilities, and hazardous materials tanks which are used in connection with utilities systems.

c. Directors responsible for facilities subject to ISCP will support the IOSC in provision of personnel, equipment, and supplies, (including training) as necessary for the IRT.

d. Environmental Coordinator, Environmental Control Division will:

(1) Perform surveillance procedures for the early detection of oil and hazardous substances discharges.

(2) Provide support (within capabilities as requested by the Dir/FE) in the performance of his IOSC duties.

e. Directorate of Supply and Services:

(1) Chief, Mobile Equipment will be responsible for detection of spills at diesel oil and gasoline storage facilities which are owned and operated by PBA and furnish tank trucks, tank cars and other appropriate equipment as required to accomplish clean-up operations.

(2) Chief, Property Division will be responsible for reporting leaks of substances covered by this plan to the IOSC.

f. Director of Industrial Operations will be responsible for detecting and reporting spills at chemical tanks/containers in connection with production facilities or operations.

g. Chief, Safety Office will provide assistance and guidance on the safety aspects of storage, use, handling and disposal of hazardous and toxic substances.

h. Chief, Plans Office, will activate the Operations Center (OC), coordinate with local officials, and provide assistance and guidance in the training of personnel.

i. Chief, Security Office, will be responsible for isolating the area and providing traffic control.

j. Staff Judge Advocate will provide assistance for any claims or legal questions that may arise.

k. Adjutant will provide photography support.

l. Chief Medical Officer will provide assistance and guidance on health and environmental aspects of storage, use and disposal of hazardous and toxic substances.

m. Public Affairs Officer will inform the next higher headquarters of anticipated news media coverage and local public reaction and will make news releases only on order of the Commander of PBA.

2. Procedures.

a. Procedures for oil spills will be used for spills of removable substances with fire and safety precautions added as appropriate.

b. Mitigation actions for spills of non-removable substances is not required at this time.

c. Mitigation/response actions for spills of non-removable substances will be implemented upon receipt of guidance from EPA.

d. Ground Tanks:

(1) Salvageable material contained within the tank and the dike will be pumped into tank car or tank truck and transported to another storage facility.

(2) Unsalvageable spilled material shall be neautralized if applicable and blotted up with sand, straw or other sorbent material. Contaminated sorbent materials will be deposited at a site designated the Environmental Protection Division. All facilites used in the clean-up operation will be decontaminated as required.

(3) The leaking facility will be repaired or replaced as required to prevent future spills.

e. Underground Storage Tanks:

(1) Salvageable material will be pumped into a tank car or tank truck and transported to another storage facility.

(2) The tank will be uncovered and the source of leak or spill determined.

(3) Contaminated earth, if any, shall be neutralized and/or removed from the site and deposited at a site designated by the Environmental Protection Division. All facilities used in the clean-up operation will be decontaminated as required.

(4) The leaking tank will be repaired or replaced as required. Clean earth will be used to backfill around the tank after repair or replacement.

f. Railroad Tank Car or Tank Truck:

(1) Materials remaining in the damaged tank will be transferred to a permanent storage facility or another tank car.

(2) In the event of a larger rupture of the tank car or tank truck, while in transit, the vehicle will be stopped immediately. Temporary earth levees will be installed in the drainage ditches in the immediate vicinity of the spill. Salvageable spilled material will be recovered. Unsalvageable spilled material will be blotted up with sorbent material. Contaminated earth and sorbent material will be placed at a site designed by the Environmental Protection Division. All facilities used in the clean-up operation will be decontaminated as required.

3. Coordination.

a. Other organizations/agencies to be notified when a discharge of oil or hazardous substances is discovered are listed in Tab a.

b. The State of Arkansas Emergency Services Office, (501-374-1201/ 501-329-5601), is designated by state law as a 24-hour/day, seven days/week contact for requesting assistance in any disaster situation including spills of oil and hazardous substances. Continuous liaison is maintained with all

Federal and State agencies, including military installations/activities, that have the capability to respond to disasters in the State of Arkansas. Requests for assistance are relayed to response elements that have capabilities appropriate to the situation.

c. In event of an emergency of such magnitude that the National Oil and Hazardous Substances Pollution Contingency Plan is implemented, the PBA IOSC will support the Regional OSC.

d. If the Department of the Army directs Army support of the EPA and US Coast Guard for a non-Army caused spill, PBA will respond within capabilities to requests from the designated FORSCOM Commander in accordance with the provisions of AR 500-60.

TAB A (REPORTING PROCEDURES) TO PBA-ISCP

1. Spill events will be reported immediately by telephonic means to the EPA Regional Office, US Coast Guard District Office or National Response Center (800) 424-8802 and the State of Arkansas Office of Emergency Services (374-1201 or 329-5601). On post spill events not entering navigable waters are to be reported promptly and completely, by EPA or USCG may not require further reporting in accordance with paragraph 2. Off-post incidents will be reported as above and to the nearest or appropriate political jurisdiction and to the RRT at the RRC.

2. Pollution Incident Report (RCS EPA-1001).

a. Medium and major spills and any discharge of more than 1,000 US gallons of oil or a spill of other hazardous liquid substance in a harmful quantity into navigable waters on or adjacent to an Army installation in the United States will be promptly reported by the IOSC by telephonic means to (800) 424-8802, or to the nearest USCG District Office, to the EPA Regional Office, and electronically through channels to HQDA (DAEN-ZCE) WASH DC 20310.

(1) When it has been determined by the OSC that a spill of a hazardous substance is in a harmful quantity or that the discharge poses a substantial threat to the public health or welfare, it will be classed as a medium or major discharge and a Pollution Incident Report will be submitted.

(2) The format for the Pollution Incident Report is given in Incl 1 to this TAB.

(3) Telephonic or electronic reports will be confirmed by a follow-up written message within 30 days after the spill to addressees listed in paragraph 3.

b. Upon discovery of a spill in which the pollutant may flow past the boundary of the installation, or a spill into navigable waters, or a spill from a vessel, the IOSC will notify the installation judge advocate's office to ensure that information, records, and samples adequate for legal purposes are obtained and safeguarded for future use.

c. Reports on PBA support provided to control non-DA spills. Reports on the commitment of PBA resources to spills, either requested by EPA, USCG, or by authority of the installation commander, in response to the provisions of the National Oil and Hazardous Substance Pollution Contingency Plan will be provided to Director of Military Support, HQDA (DAMO-MS) WASH DC 20310, in accordance with the provisions of AR 500-60.

3. Pollution Incident Reports as required will be submitted to:

a. Through ARRCOM and DARCOM to: HQDA (DAEN-ZCE)
Washington, D.C. 20310

b. Environmental Protection Agency
Region VI, Suite 1600
1600 Patterson St.
Dallas, TX 75201
Tel: (214) 749-3840

c. 2nd Coast Guard District
Federal Building
1520 Market Street
St. Louis, MO 63103
Duty Officer: (314) 622-4614

d. State of Arkansas
Office of Emergency Services
24 hr, 7day/week Telephonic Contact:
374-1201 or 329-5601

1 Incl
as

ENCLOSURE I (FORMAT FOR POLLUTION INCIDENT REPORT (RCS EPA-1001))
TO TAB A TO PBA-ISCP

Item	Data
1	Name and location of installation.
2	Commander of installation and his phone number.
3	Date and time (GMT) of incident or time of discovery.
4	Severity of incident. Specify size of oil discharge (major, medium, minor).
5	Location of incident and specific areas affected by spill.
6	Cause and source of incident.
7	Type and estimated amount (barrels, gallons, liters, pounds) of pollutant. If applicable, length by width of slick.
8	Samples taken (yes or no).
9	Damage impact on surroundings (fish, wildlife, and underground waters (e.g., drinking water)).
10	Potential dangers (fire, explosion, toxic vapor, etc.).
11	Corrective action to eliminate pollution source.
12	Corrective action to remove pollutant.
13	Assistance required.
14	Estimated completion date of remedial actions.
15	Anticipated or actual reaction by news media and public to the incident.
16	Other items required in the regional contingency plan and a general discussion of the incident.

APPENDIX D

INVENTORY OF MATERIALS STORED AT OLD TOXIC STORAGE YARD IN 1980 (SITE 7A)

APPENDIX D

INVENTORY OF MATERIALS STORED AT OLD TOXIC STORAGE YARD IN 1980 (SITE 7A)

(These materials may be hazardous wastes by definition or testing if declared wastes in the future.)

Stock Number	Nomenclature	Quantity
No NSN	Shell pluma C4 Oil 10w	1 drum
No NSN	Shell rotella oil F/diesels 40	1 drum
6810 00 174 6581	Sodium hydroxide (tech)	20 drums
6810 00 264 6521	Soda ash, sodium carbonate	10 lb
6810 00 262 8567	Soda ash	15 lb
6810 00 270 6207	Monoethanolamine (MEA)	12 drums
6810 00 281 2033	Ammonium chloride	41 lb
6840 00 270 8262	Insecticide chlordane emulsifiable concentrate	88 cans
6840 00 281 2030	Sodium arsenite	1 drum
6840 00 381 3462	Insecticide DDT 55-18	13 drums
6840 00 543 7825	Insecticide chlordane, 5%	6 drums
6840 00 685 5437	Insecticide malathion	16 drums
6840 00 685 5438	Insecticide malathion, 57%	47 drums
6840 00 753 5038	Insecticide diazinon, powder form, 2%	41 drums
6840 00 782 3925	Insecticide diazinon emulsifiable concentrate	34 drums
6840 00 926 1481	Malathion technical grade B	2 drums
6840 00 932 7297	Sevin sprayable, 80% wettable powder	116 bags
6850 00 264 8042	Decontaminating agent, STB	13 drums
6850 00 276 6342	Decontaminating agent, NC	1,048 drums
6850 00 297 6653	Decontaminating agent, STB	282 drums
6850 00 656 0926	Antisetting compound, decontaminating slurry M2	48 drums

APPENDIX D (continued)

Stock Number	Nomenclature	Quantity
6850 00 753 4827	Decontaminating agent, DS-2 (quart)	4,644 drums
6850 00 753 4870	Decontaminating agent, DS-2 (gallon)	5,187 drums
6850 00 827 2791	Decon. agent and biological	2 gallons
8110 00 082 2626	Drum, metal, empty	2 each